NL INDUSTRIES/TARACORP SUPERFUND SITE GROUP
Leed Environmental, Inc.
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July 24, 2018

By Electronic Mail

Ms. Sheri L. Bianchin
Remedial Project Manager
Institutional Controls Coordinator
U.S. Environmental Protection Agency Region 5
77 West Jackson Boulevard (SR-6J)
Chicago, IL 60604

Re: NL Industries/Taracorp Superfund Site; Granite City, Illinois
Scope of Work for Five-Year Review Groundwater Activities

Dear Ms. Bianchin:

As follow-up to our recent telephone conversation, this letter has been prepared on behalf of the NL Industries/Taracorp Superfund Site Group (Group) to summarize the groundwater activities that the Group plans to perform in conjunction with the U.S. Environmental Protection Agency's (EPA) five-year review for the NL Industries/Taracorp Superfund Site (site) in Granite City, Illinois.

Upon receipt of EPA's approval to proceed with groundwater monitoring activities, the Group plans to authorize its consultant, Environmental Works, Inc. (EWI), to perform the work. As you know, it is the Group's intention to perform the work in a manner consistent with the Group's work during previous five-year reviews at the site. Specifically, the work will be performed in accordance with the attached document, titled Scope of Work – Groundwater Monitoring for Five-Year Review (Scope of Work), which EPA previously reviewed and approved (and which the Group successfully implemented as part of EPA's five-year reviews in 2008-2009 and 2013-2014), and in accordance with EWI's July 2018 amendments to the Quality Assurance Project Plan (QAPP Amendments), also attached.

As shown on Figure 3 of the Scope of Work, there are 16 groundwater monitoring wells at the site (MW-101, MW-104, MW-105S, MW-105D, MW-107S, MW-107D, MW-108S, MW-108D, MW-108X, MW-109S, MW-109D, MW-109X, MW-112S, MW-112D, MW-113S, and MW-113D). Monitoring well GMMW-103R, which is referenced in the text of the Scope of Work, was damaged, abandoned, and removed from the monitoring well network at the site with EPA's approval in 2009.

The work to be performed by the Group and EWI is summarized as follows:

TASK 1 – MONITORING WELL ASSESSMENT AND REDEVELOPMENT

Because the groundwater monitoring wells have not been inspected or sampled since 2014, EWI will assess the current condition of the 16 monitoring wells that remain at the site. Prior to the monitoring well assessment, the Group's project coordinator will notify EPA and Illinois EPA regarding the schedule for the work. The Group's project coordinator will also send notifications to the property owners regarding the schedule.

During the monitoring well assessment, EWI will locate the monitoring wells and assess the condition of the protective surface casings and surface seals to determine if the integrity of the surface seals has been compromised. The wells will be opened and allowed to equilibrate prior to gauging. Each well will be gauged with an electronic water level meter to determine the depth to groundwater and total depth. The installed total depth of the well will be compared to the gauged total depth to determine whether a significant amount of sediment has accumulated in the well. EWI will redevelop the wells, pursuant to the Scope of Work, to remove suspended solids prior to groundwater sampling activities.

TASK 2 – LEACHATE EVALUATION AND DISPOSAL

During the monitoring well assessment, EWI will also measure the level of leachate, if any, within the leachate collection sump of the closed Taracorp pile. If leachate is determined to be present, a sample of leachate will be collected and analyzed for silver, arsenic, barium, biological oxygen demand, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, selenium, total suspended solids, zinc, cyanide, oil and grease, phenols, pH, and temperature. Upon completion of laboratory testing, a letter will be submitted to the City of Granite City Regional Waste Water Treatment Plant to provide the data and to request authorization to discharge the leachate into the sanitary sewer system. Groundwater from the redevelopment of monitoring wells will be combined with the leachate prior to sampling and discharge.

TASK 3 – GROUNDWATER SAMPLING AND ANALYSIS

EWI will collect groundwater samples from the monitoring wells at the site using low-flow sampling techniques and utilizing EPA-approved protocols for low-flow sampling. The monitoring wells will be purged at a low rate (typically 100 to 400 milliliters per minute) in order to minimize groundwater drawdown in the wells. Groundwater quality parameters of pH, temperature, specific conductivity, turbidity, dissolved oxygen, and oxidation/reduction potential (ORP) will be collected every three to five minutes with a low-through cell water quality meter. The groundwater samples will be collected when the well has stabilized. Stabilization is achieved when three successive readings are within $\pm$0.1 units for pH, $\pm$3% for conductivity, $\pm$10 millivolts ORP, and $\pm$10% for turbidity and dissolved oxygen. The groundwater samples will be submitted to TestAmerica, University Park, Illinois, for analysis of total (unfiltered) and dissolved (filtered) lead, cadmium, and zinc.

Equipment decontamination, sample containers and preservatives, sample custody and shipment, and related activities will follow the procedures in the Scope of Work. The laboratory will analyze the groundwater samples for lead, cadmium, and zinc using EPA Method SW 6010B.

TASK 4 – LEACHATE DISPOSAL

Upon receipt of approval from the Granite City Waste Water Treatment Plant, EWI will mobilize to the site and discharge leachate and redevelopment water from the groundwater monitoring wells to the municipal sanitary sewer system.

TASK 5 – DATA VALIDATION AND REPORTING

After laboratory testing of groundwater samples has been completed, EWI will validate the data using EPA-approved methodologies in accordance with data validation guidelines for inorganic parameters (to ensure that it meets precision, sensitivity, accuracy, completeness, representativeness, and comparability requirements), as outlined in the Scope of Work.

Upon completion of data validation activities, EWI will evaluate the data generated from the monitoring event and prepare a five-year review groundwater monitoring report documenting the results of sampling activities. Specifically, the report will include at least the following information:

- Description of site preparation activities, including:
  - Status and integrity of the monitoring well network
  - Summary of well assessment and redevelopment activities
- Summary of water level data, including:
  - Water level data summary tables
  - Potentiometric map
- Summary of groundwater quality data, including:
  - Validated analytical data summary tables
  - Discussion of data validation results
  - Evaluation of groundwater quality

The report will also include a brief narrative description of the conclusions of the groundwater monitoring event and any recommendations that may be appropriate for future activities. The Group will submit the report to EPA and Illinois EPA.

As indicated above, EWI's work will be performed in accordance with the EPA-approved Scope of Work and EWI's QAPP Amendments, copies attached.

Please contact this office if additional information or clarification is needed at this time.

Very truly yours,

LEED ENVIRONMENTAL, INC.

Jeffrey A. Leed
Project Coordinator

attachment

cc: Mr. Brian Conrath – Illinois EPA (with attachment, by electronic mail)
Mr. Tom Miller – Illinois EPA (with attachment, by electronic mail)
Mr. Anthony Moore/Ms. Barbara Garcia – Environmental Works, Inc. (with attachment, by electronic mail)
Technical Committee, NL Industries/Taracorp Superfund Site Group

NL INDUSTRIES/TARACORP SUPERFUND SITE
GRANITE CITY, ILLINOIS

SCOPE OF WORK
GROUNDWATER MONITORING FOR FIVE-YEAR REVIEW

October 2008
Revised December 2008

NL INDUSTRIES/TARACORP SUPERFUND SITE GROUP
Leed Environmental, Inc.
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2209 Quarry Drive, Suite C-35
Reading, PA 19609
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December 10, 2008

Ms. Sheri Bianchin
Remedial Project Manager
U.S. Environmental Protection Agency
77 West Jackson Boulevard (SR-6J)
Chicago, IL 60604-3590

Re: NL Industries/Taracorp Superfund Site; Granite City, Illinois

Dear Ms. Bianchin:

Thank you for your November 28, 2008 letters that approved, with modifications, the NL Industries/Taracorp Superfund Site Group's (Group) documents for the NL Industries/ Taracorp Superfund Site in Granite City, Illinois, which are entitled:

- Scope of Work – Groundwater Monitoring for Five-Year Review; and
- Scope of Work – Soil Sampling and Analysis for Five-Year Review.

Enclosed for your records are the Group's responses to your comments, two bound paper copies of both documents, and a CD that includes scanned copies of both documents.

Please let me know if you have questions or need clarification or additional information. Thank you.

Very truly yours,

LEED ENVIRONMENTAL, INC.

Jeffrey A. Leed
Project Coordinator

enclosures
cc: Mr. Doyle Wilson – Illinois EPA (with two bound copies and CD)
Ms. Meredith Kenworthy – Environmental Works, Inc.
(with one bound copy of Scope of Work for Soil and one CD)
Mr. Jack Kratzmeyer – ARCADIS U.S., Inc.
(with one bound copy of Scope of Work for Groundwater and one CD)
Kathleen Whitby, Esq. – Spencer Fane Britt & Browne LLP (with CD)
Technical Committee, NL Industries/Taracorp Superfund Site Group (with CD)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF

(SR-6J)

November 28, 2008

Mr. Jeff Leed,
Leed Environmental, Inc.
Van Reed Office Plaza
2209 Quarry Drive, Suite C-35
Reading, PA 19609

RE: Approval with Modification to the Scope of Work- Groundwater Monitoring for the Five-Year Review; NL Industries /Taracorp Superfund Site; Granite City, IL

Dear Mr. Leed:

The United States Environmental Protection Agency (U.S. EPA) is in receipt of the Scope of Work – Groundwater Monitoring for the Five-Year Review dated October 23, 2008; that deliverable was submitted for groundwater monitoring associated with the NL Industries/ Taracorp Superfund Site in Granite City, IL (the Site). The Scope of Work (SOW) was discussed during the Five-Year Review inspection conducted on November 20, 2008. Based upon our review and subsequent discussion, U.S. EPA hereby approves the SOW with the enclosed modifications. Please provide revisions to the SOW or other written documentation to acknowledge that the requested modifications have been incorporated into the SOW.

If you have any questions or concerns, please feel free to contact me at bianchin.sheri@epa.gov or 312-886-4745.

Sincerely,

Sheri L. Bianchin
Remedial Project Manager

enclosure

cc: Doyle Wilson, Illinois Environmental Protection Agency (IEPA)
bcc

ENCLOSURE

Required Modification to the Scope of Work- Groundwater Monitoring for the Five-Year Review; NL Industries /Taracorp Superfund Site; Granite City, IL

General Comments

1. Please notify U.S. EPA and IEPA as soon as any of the field work and sampling schedules are firmed up so that U.S. EPA and IEPA have adequate time to plan to conduct oversight if desired.

Specific Comments

2. Page 3.1, Section 3.2, *Monitoring Well Assessment.* Please add the following step, contact U.S. EPA and IEPA to discuss the findings, next steps and scheduling for the water groundwater sampling event after the field reconnaissance to assess the monitoring wells.

3. Page 4-2, Section 4.0, *Groundwater Monitoring.* If possible, after laboratory testing has been completed and before the final report is prepared and submitted to EPA, the Group's project coordinator and the contractor's project manager will discuss the laboratory data with U.S. EPA and IEPA's project mangers. Also, please include a timeframe when that communication will occur such as the preliminary data will be discussed within 2 weeks of the groundwater sampling event.

4. Page 4.6, Section 4.6, *Laboratory Section.* Please provide the Statement of Qualifications for the laboratory as offered in this section of the SOW.

5. Page 6-1, Section 6.2, *Final Report.* Please include a timeframe for all aspects of the field work and the Final Report submission. Additionally, if possible, EPA requests that the work be completed on an expedited time schedule due to the deadline for the Five-Year Review report.

SCOPE OF WORK
GROUNDWATER MONITORING FOR FIVE-YEAR REVIEW
NL INDUSTRIES/TARACORP SUPERFUND SITE; GRANITE CITY, ILLINOIS

General Comments

1. **Please notify U.S. EPA and IEPA as soon as any of the field work and sampling schedules are firmed up so that U.S. EPA and IEP have adequate time to plan to conduct oversight if desired.**

   Response: The Group's project coordinator will notify the EPA and Illinois EPA project managers as soon as any of the field work and sampling schedules are defined so that EPA and Illinois EPA will have adequate time to plan and conduct oversight, if desired. The text of the document has been revised to include a new Section 7.0 (Schedule) to address this requirement.

Specific Comments

2. **Page 3-1, Section 3.2, Monitoring Well Assessment. Please add the following step, contact U.S. EPA and IEPA to discuss the findings, next steps, and scheduling for water groundwater sampling event after the field reconnaissance to assess the monitoring wells.**

   Response: After the field reconnaissance has been performed to assess the condition of the monitoring wells, the Group's project coordinator will contact the EPA and Illinois EPA project managers to discuss the findings, next steps, and scheduling for subsequent activities and the groundwater sampling event. This requirement has been inserted on page 3-1, Section 3.2, Monitoring Well Assessment, and in Section 7.0, Schedule, of the document.

3. **Page 4-2, Section 4.0, Groundwater Monitoring. If possible, after laboratory testing has been completed and before the final report is prepared and submitted to EPA, the Group's project coordinator and the contractor's project manager will discuss the laboratory data with U.S. EPA and IEPA's project managers. Also, please include a timeframe when that communication will occur such as the preliminary data will be discussed within two weeks of the groundwater sampling event.**

   Response: Page 4-2 has been revised to include new Section 4.8, Discussion of Preliminary Groundwater Data, to address this information. Specifically, Section 4.8 indicates that after laboratory testing has been completed and before the final report is prepared and submitted to EPA, the Group's project coordinator and the contractor's project manager will discuss the preliminary laboratory data with the EPA and Illinois EPA project managers. Also, Section 4.8 indicates that: (a) the Group currently anticipates that laboratory testing will be completed within about two weeks following receipt of the samples at the laboratory; (b) preliminary data are expected to be received from the laboratory within about one week after the laboratory testing has been completed; (c) the Group's project coordinator and the contractor's project manager will attempt to discuss the preliminary data with the

EPA and Illinois EPA project managers as soon as possible following receipt of the preliminary data; and that (d) the Group will attempt to complete this work on an expedited schedule due to the deadline for the Five-Year Review Report. The information has also been included in Section 7.0, Schedule, of the document.

4. **Page 4-2, Section 4.2, Laboratory. Please provide the Statement of Qualifications for the laboratory as offered in this section of the State of Work.**

   Response: Page 4-2, Section 4.2, Laboratory, has been revised to confirm that the Group will provide the Statement of Qualifications for the laboratory to EPA and Illinois EPA.

5. **Page 6-1, Section 6.2, Final Report. Please include a timeframe for all aspects of the field work and the Final Report submission. Additionally, if possible, EPA requests that the work be completed on an expedited time schedule due to the deadline for the Five-Year Review Report.**

   Response: As indicated in the response to comment #1 above, the text of the document has been revised to include a new Section 7.0, Schedule, to address the timeframe for completion of all aspects of the field work and the submission of the Final Report. Section 7.0 indicates that: (a) the Group will attempt to complete the work on an expedited schedule due to the deadline for the Five-Year Review Report; (b) the Group's project coordinator will provide periodic schedule updates to EPA; and (c) the Group's project coordinator will advise EPA as soon as any of the field work and sampling schedules are defined so that EPA and Illinois EPA will have adequate time to conduct oversight, if desired.

   Because the Group does not currently know whether any monitoring wells will require repairs, replacement, or significant well redevelopment by subcontractors (Sections 3.3 and 3.4 of the Scope of Work), the Group is currently unable to define the overall schedule for completing the work. To address this current uncertainty and as noted in response to comment #2 above, Section 3.2 of the Scope of Work has been revised to indicate that after the field reconnaissance has been completed to assess the condition of the monitoring wells, the Group's project coordinator will contact the EPA and Illinois EPA project managers to discuss the findings, next steps, and scheduling for subsequent activities and the groundwater sampling event. This information has also been included in new Section 7.0, Schedule.

Other Revisions

1. Table 1, Page 2-1, has been revised to reflect the current contact person for Mayco Industries, Inc./Metalico.

SCOPE OF WORK
GROUNDWATER MONITORING FOR FIVE-YEAR REVIEW

NL INDUSTRIES/TARACORP SUPERFUND SITE
GRANITE CITY, ILLINOIS

Prepared by:
NL Industries/Taracorp Superfund Site Group

Prepared for:
U.S. Environmental Protection Agency

October 2008
Revised December 2008

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1.1 Purpose

In June 2008, the U.S. Environmental Protection Agency (EPA) requested that the NL Industries/Taracorp Superfund Site Group perform groundwater monitoring and related activities at the NL Industries/Taracorp Superfund Site in conjunction with EPA's five-year review. During a subsequent telephone conference call in September 2008, EPA requested that the NL Industries/Taracorp Superfund Site Group prepare a scope of work to outline the work to be performed. The NL Industries/Taracorp Superfund Site Group prepared this Scope of Work – Groundwater Monitoring for Five-Year Review (Scope of Work) to define the procedures to be used by the NL Industries/Taracorp Superfund Site Group and its contractor to inspect the groundwater monitoring wells at the site, to prepare the wells for sampling, to collect and analyze groundwater samples from the wells, and to perform related activities as part of EPA's 2008 – 2009 five-year review.

1.2 Site Location and History

- **Site Location**

  The NL Industries/Taracorp Superfund Site (the "site") is located in a heavily industrialized section of Granite City, Illinois, a community of approximately 40,000 people located about 2 miles east of St. Louis, Missouri. The main industrial site (Figure 1 and Figure 2), where lead-acid battery breaking and secondary lead reclamation operations were previously performed, is located at 16th Street and Cleveland Boulevard in Granite City.

- **Site History**

  During the period from 1903 until 1983, NL Industries, Inc. performed secondary lead reclamation at the main industrial site. Lead-acid battery breaking operations were performed in conjunction with secondary lead reclamation activities from the 1950s until 1983. In 1981, St. Louis Lead Recyclers, Inc. (SLLR) began to separate various components of an on-site waste pile in order to recycle lead-containing materials, hard rubber battery cases, and plastic battery cases. SLLR operations ceased in 1983.

  In December 1982, EPA proposed to include the site on the National Priorities List (NPL). In May 1985, a former owner of the site, NL Industries, Inc., voluntarily entered into an Agreement and Administrative Order by Consent with EPA and the Illinois Environmental Protection Agency (Illinois EPA) to perform a remedial investigation and feasibility study (RI/FS) for the site. The site was added to the NPL in 1986. NL Industries initiated the remedial investigation in January 1987. EPA selected the remedy for the site and issued a Record of Decision (ROD) in March 1990 and a Unilateral Administrative Order (UAO) in November 1990. After EPA rejected an offer from a group of potentially responsible parties (PRPs) to perform a portion of the required work, EPA initiated and performed remedial activities at 738 properties from 1993 to 1998.

In 1994 and as a result of ongoing litigation with the PRPs, EPA reopened the ROD and accepted public comments. In September 1995, EPA reaffirmed the remedial action plan and added a groundwater containment component in a Decision Document/Explanation of Significant Differences.

During the period from June 1998 to May 2000, the Group performed remedial activities at the site with oversight provided by EPA and the Army Corps of Engineers. The work performed by the Group included remedial activities associated with 802 residential lots (770 stack emission lots and 32 remote fill lots) and paving of 21 alleys not previously addressed by EPA. In addition, the Group performed the following activities at the main industrial site:

- Consolidation of on-site hazardous material into the existing Taracorp pile.
- Construction of a new cell with an engineered RCRA-grade liner and a leachate collection system.
- Construction of an engineered RCRA-grade cap over the entire pile.
- Construction of storm water and erosion controls on and around the capped pile.
- Restoration of the site.

Since the time that remedial activities were completed, the Group has conducted post-remediation operation and maintenance activities at the site pursuant to an Operation and Maintenance Plan approved by EPA.

As indicated above, EPA added a groundwater containment component to the remedy for the site in the Decision Document/Explanation of Significant Differences issued in September 1995. After additional groundwater wells were installed in 2000 and additional groundwater monitoring was performed, EPA determined that:

- The extent of groundwater contamination was very limited.

- The extent of groundwater contamination would likely decrease even further in the future.

- There was no legitimate reason to require the installation of a groundwater containment system at the site.

- The groundwater remedy for the site would be limited to additional monitoring, with development of a contingency plan to address any exceedances of groundwater standards in the event they occur outside of the perimeter monitoring wells in the future.

The Group submitted a Groundwater Monitoring Plan to EPA in December 2000 and, following receipt of EPA's approval in August 2001, submitted additional information in September 2001 and subsequently conducted annual groundwater monitoring events in 2001, 2002, and 2003. Following completion of the 2003 annual groundwater monitoring event, the Group submitted a letter to EPA in August 2003 which recommended that:

- Future groundwater monitoring should be limited to the monitoring wells within the property boundaries of the main industrial site.

- Off-site downgradient monitoring wells installed at the Granite City Steel facility and the Terminal Railroad of St. Louis property should no longer be sampled as part of the future monitoring program.

- The remote fill area monitoring wells in Venice Township and Eagle Park Acres should be eliminated from the future monitoring program.

Upon receipt of EPA's approval, the Group abandoned 18 monitoring wells at the site in July 2005 and submitted a Monitoring Well Abandonment Report to EPA in September 2005. In addition, EPA determined that groundwater monitoring for the remaining 17 wells at the main industrial site should be performed once every five years in conjunction with EPA's five-year reviews.

1.3 Organization

This Scope of Work is organized in the following manner:

- **Section 1, Introduction:** Describes the site location, history of activities of the site, and the purpose of this Scope of Work.

- **Section 2, Pre-Mobilization Activities:** Describes the work activities to be a performed by the Group and its contractor before the contractor mobilizes to the site.

- **Section 3, Monitoring Well Assessment and Redevelopment:** Describes the work to be performed by the Group and its contractor to assess the current condition of the monitoring wells and to prepare the monitoring wells for sampling, and to evaluate the leachate within the leachate collection system of the closed Taracorp pile.

- **Section 4, Groundwater Monitoring:** Describes the groundwater monitoring activities to be performed by the Group and its contractor.

- **Section 5, Data Quality Objectives:** Describes the data quality objectives, the quality control samples, and the data validation activities to be performed as part of the project.

- **Section 6, Recordkeeping and Reporting:** Describes the records to be maintained and the reporting to be performed by the Group and its contractor.

- **Section 7, Schedule:** Describes the schedule for completing the work.

- **Section 8, References:** Includes a list of documents referenced in this Scope of Work.

2.1 Contractor Selection

The Group will select a contractor to perform the work outlined in this Scope of Work. The Group will provide the name and qualifications of the contractor to EPA for review and approval.

2.2 Access

Before the Group's contractor mobilizes to the site, the Group will notify the owners of the properties on which groundwater activities will be performed. The Group has previously obtained access to the properties in conjunction with previous work at the site. Therefore, the Group anticipates that letters will be provided to the owners of the properties listed on Table 1:

Table 1
Monitoring Wells and Property Owners

Property Owner	Monitoring Wells	Contact Person/ Mailing Address	Planned Activities
Metalico of Illinois, Inc.	MW-101 MW-104 GMMW-105S GMMW-105D GMMW-107S GMMW-107D GMMW-108X GMMW-108S GMMW-108D	Mr. Daniell Hill Operations Manager Mayco Industries, Inc. (A Metalico Company) 1200 16th Street Granite City, IL 62040 Copies of communications/ documents also to: Ms. Joyce Morales-Caramella Environmental Safety and Health Director Mayco Industries, Inc. 18 West Oxmoor Road Birmingham, AL 35209	The Group will notify the property owner/contact person about the work activities and schedule.
Mr. Scott Oney, State Street Warehouse	GMMW-103R GMMW-109X GMMW-109S GMMW-109D GMMW-112S GMMW-112D	Mr. Scott Oney State Street Warehouse & Transfer 1459 State Street Granite City, IL 62040	The Group will notify the property owner/contact person about the work activities and schedule.
Mr. John G. Obucina	GMMW-113S GMMW-113D	Mr. John G. Obucina 15th and State Streets Granite City, IL 62040	The Group will notify the property owner/contact person about the work activities and schedule.

2.3 Health and Safety

The Group's contractor will be responsible for preparation and implementation of a health and safety program. As part of those requirements, the Group's contractor will prepare a Health and Safety/Contingency Plan to meet the requirement of 29 CFR 1910.120. The Health and Safety/Contingency Plan will establish the protocols necessary for the recognition, evaluation, and control of all hazards associated with each task to be performed by the contractor and its subcontractors. The Health and Safety/Contingency Plan will address site-specific safety and health requirements and procedures based on site-specific conditions and will also include a contingency plan to address the actions to be taken in the event of situations that could impact public health, safety, and the environment during the implementation of remedial activities.

Prior to initiation of work at the site, all field team members will be required to read and familiarize themselves with the Health and Safety/Contingency Plan. A mandatory health and safety meeting will be held with the project field team to discuss the history of the site, potential health and safety concerns associated with the project, required level of personal protective equipment, and the procedure for personnel and sampling equipment decontamination. Daily safety meetings will be held at the site, in accordance with the Health and Safety/Contingency Plan, while work is being performed. The daily meetings will include discussions of the work to be performed that day, the responsibilities of the field team members, and potential health and safety issues.

The health and safety program will be consistent with the Site-Specific Health and Safety Plan (Appendix 1), which was prepared by ARCADIS Geraghty & Miller (ARCADIS) and submitted to EPA in August 2000 as part of ARCADIS' Final Pre-Design Investigation Work Plan for Groundwater.

3.1 Overview

Because the groundwater monitoring wells at the main industrial site have not been inspected or sampled since 2003, the Group's contractor will conduct a site visit prior to the groundwater monitoring event to:

- Assess the current condition of the 17 monitoring wells at the main industrial site.
- Evaluate the leachate, if any, within the leachate collection system of the closed Taracorp pile at the main industrial site.

The site assessment activities are described in additional detail in Sections 3.2 – 3.5, below.

3.2 Monitoring Well Assessment

As indicated above, the Group's contractor will conduct a site visit prior to the groundwater monitoring event to inspect and assess the condition of the 17 monitoring wells at the main industrial site (Figure 3). At that time, the Group's contractor will locate the monitoring wells and assess the condition of the protective surface casings and surface seals to determine if the integrity of the surface seals has been compromised. The wells will be opened and allowed to equilibrate prior to gauging. Each well will be gauged with an electronic water level meter to determine the depth to groundwater and total depth. The installed total depth of the well will be compared to the gauged total depth to determine if a significant amount of sediment has accumulated in the well. Monitoring well construction details are provided in Appendix 2. After the field reconnaissance to assess the condition of the monitoring wells has been performed, the Group's project coordinator will contact the EPA and Illinois EPA project managers to discuss the findings, next steps, and scheduling for subsequent activities and the groundwater sampling event.

3.3 Monitoring Well Repair

If a well is damaged, the Group's contractor will attempt to repair the well with locally available tools and materials. If a monitoring well has suffered significant damage and more extensive repairs or replacement are required, the Group's contractor will solicit proposals for the repair work from local drilling subcontractors, which will be provided to the Group for review and approval. The Group will advise EPA if extensive repairs or replacements are required.

3.4 Monitoring Well Redevelopment

If the Group's contractor determines that significant amounts of sediment have accumulated in the monitoring wells, the Group's contractor will solicit proposals for well redevelopment from local subcontractors, which will be provided to the Group for review and approval. The Group will advise EPA if well redevelopment is necessary.

If significant amounts of sediment have accumulated in the bottoms of the wells, the wells will be redeveloped via the air lift method. Compressed air will be jetted in the bottom of the wells to loosen the sediment. The suspended sediment will be removed by pumping at least 10 well volumes of groundwater from the wells. The submersible pumps will be decontaminated between well locations, and new disposable tubing will be used with the pump at each well.

During the redevelopment, water quality parameters (pH, temperature, specific conductivity, turbidity, dissolved oxygen, and oxidation/reduction potential (ORP)) will be collected to monitor stability. Stability will be determined when at least 10 well volumes have been purged from the well, the groundwater flow is nearly clear, and successive measurements of water quality parameters are within ± 0.1 units for pH, ± 3% for conductivity, ± 10 millivolts for redox potential (Eh), and ± 10% for turbidity and dissolved oxygen. At a minimum, water quality parameters will be collected at least once during each well volume removed.

Groundwater from redevelopment activities will be collected and containerized as described in additional detail in Section 3.4, below. The containers will be conveyed inside the fenced area of the former BV&G Transport facility (now owned by the NL Industries, Inc. Generator Site Group, L.L.C.) for temporary staging pending the completion of laboratory testing described in Section 3.4.

3.4 Leachate Evaluation and Disposal

During the monitoring well assessment, the Group's contractor will also measure the level of leachate, if any, within the leachate collection sump of the closed Taracorp pile. If leachate is determined to be present, a sample of leachate will be collected for analysis of silver, arsenic, barium, biological oxygen demand, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, selenium, total suspended solids, zinc, cyanide, oil and grease, phenols, pH, and temperature. Upon completion of laboratory testing, a letter will be submitted to the City of Granite City Regional Waste Water Treatment Plant along with the sample results to request authorization to discharge the leachate into the sanitary sewer system. Additionally, the groundwater collected during the redevelopment of the monitoring wells will be combined with the leachate prior to sampling and discharge.

4.1 Overview

Upon completion of the monitoring well assessment and redevelopment activities described in Section 3.0, the Group's contractor will mobilize to the site to perform groundwater sampling activities.

4.2 Groundwater Sampling and Analysis

Groundwater sampling activities will be performed in accordance with the September 2001 Groundwater Monitoring Plan, prepared by ARCADIS on the Group's behalf, which was approved by EPA with several modifications in August 2001. Specifically, groundwater sampling field protocols (including sounding the monitoring wells, measuring the water levels, purging the wells, field analysis, and groundwater sampling) will follow the procedures in Section 3.0 of the September 2001 Groundwater Monitoring Plan (Appendix 3).

Groundwater samples will be collected from the 17 monitoring wells listed on Table 1 by the Group's contractor using low-flow sampling techniques. The Group's contractor will utilize EPA-approved protocols for low-flow sampling to collect the groundwater samples. The monitoring wells will be purged at a low rate (100 to 400 milliliters per minute) in order to minimize groundwater drawdown in the wells. Groundwater quality parameters of pH, temperature, specific conductivity, turbidity, dissolved oxygen, and ORP will be collected every three to five minutes with a flow-through cell water quality meter. The groundwater samples will be collected when the well has stabilized. Stabilization is achieved when 3 successive readings are within ± 0.1 units for pH, ± 3% for conductivity, ± 10 millivolts ORP, and ± 10% for turbidity and dissolved oxygen.

The groundwater samples will be submitted to the project laboratory for analysis of total (unfiltered) lead, cadmium, and zinc. Based upon the results of the 1999 – 2000 pre-design field investigation, EPA determined that lead, cadmium, and zinc were the most frequently detected analytes with the highest quantified concentrations in groundwater collected from the monitoring wells at the main industrial site. EPA previously selected the long-term groundwater monitoring requirements at the site based upon the results of the pre-design groundwater investigation.

4.3 Equipment Decontamination

During groundwater sampling activities, the Group's contractor will follow the applicable equipment decontamination guidelines provided in Appendix 3.

4.4 Sample Custody, Sample Handling, and Shipment Procedures

Sample custody, sample handling, and sample shipment procedures will follow the applicable procedures outlined in the Groundwater Monitoring Plan (Appendix 3) and the applicable portions of the Quality Assurance Project Plan (Appendix 4). Groundwater samples will remain in the custody of field sampling personnel from the time of sample

collection until transfer to a representative of a courier service for delivery to the laboratory. Laboratory custody procedures will be followed upon receipt of samples at the laboratory.

4.5 Sample Containers and Preservatives

The use of sample containers and sample preservatives will follow the applicable portions of the Quality Assurance Project Plan (Appendix 4). The groundwater samples to be analyzed for lead, cadmium, and zinc will be preserved with nitric acid to a pH less than 2.0 standard units.

4.6 Laboratory

The Group's contractor will submit the groundwater samples to the designated laboratory, which is:

TestAmerica Laboratories, Inc.
University Park, Illinois

The Group will provide a copy of the laboratory's Statement of Qualifications to EPA and Illinois EPA. STL Laboratories, now known as TestAmerica Laboratories, Inc., analyzed groundwater samples previously collected at the site.

4.7 Laboratory Method and Sample Holding Time

The laboratory will analyze the groundwater samples for lead, cadmium, and zinc using EPA Method SW-6010B. Groundwater samples properly preserved with nitric acid have a holding time of six months.

4.8 Discussion of Preliminary Groundwater Data

After laboratory testing has been completed and before the final report is prepared and submitted to EPA, the Group's project coordinator and the contractor's project manager will discuss the preliminary laboratory data with the EPA and Illinois EPA project managers.

At the present time, the Group anticipates that the laboratory testing of the groundwater samples will be completed within about two weeks following receipt of the samples at the laboratory. The Group also currently anticipates that preliminary laboratory data will be received from the laboratory within about one week after the laboratory testing has been completed. The Group's project coordinator and the contractor's project manager will attempt to discuss the preliminary data with the EPA and Illinois EPA project managers as soon as possible following receipt of the preliminary data.

Due to EPA's deadline for preparing and finalizing the Five-Year Review Report, the Group will attempt to complete this work on an expedited schedule.

5.1 Quality Control Samples

The overall quality assurance objective is to ensure that monitoring data of known and acceptable quality are obtained.

The Group's contractor will collect quality control and quality assurance samples during the groundwater monitoring event. Two matrix spike/matrix spike duplicates and two duplicate samples will be collected and submitted for analysis of total lead, cadmium, and zinc. Quality control and quality assurance will follow the applicable protocols in the Quality Assurance Project Plan (Appendix 4).

5.2 Data Validation

Upon receipt of the laboratory data, the Group's contractor will validate the data using EPA-approved methodologies in accordance with data validation guidelines for inorganic parameters to ensure that it meets precision, sensitivity, accuracy, completeness, representativeness, and comparability requirements. The laboratory quality assurance/ quality control reporting will correspond to ARCADIS Level II deliverables (Appendix 5), which was excerpted from the ARCADIS' September 2001 Groundwater Monitoring Plan. The Group's contractor will enter the validated data into an electronic database.

6.1 Field Logbooks

The Group's contractor will document all field activities in a bound field logbook. Field logbooks and documentation of field activities will follow the applicable procedures in the Quality Assurance Project Plan (Appendix 4).

6.2 Final Report

Upon completion of laboratory testing and data validation activities, the Group's contractor will evaluate the data generated from the monitoring event and prepare a Five-Year Review Groundwater Monitoring Report documenting the results of sampling activities. Specifically, the report will include at least the following information:

- Description of site preparation activities, including:
  - Status and integrity of the monitoring well network.
  - Summary of well assessment and redevelopment activities.
- Summary of water level data, including:
  - Water level data summary tables
  - Potentiometric map.
- Summary of groundwater quality data, including:
  - Validated analytical data summary tables.
  - Discussion of data validation results.
  - Evaluation of groundwater quality.

The report will also include a brief narrative description of the conclusions of the groundwater monitoring event and any recommendations that may be appropriate for future activities. The report will be submitted to EPA.

6.3 Progress Reports

The status of groundwater activities will be summarized in quarterly progress reports that are prepared and submitted by the Group's project coordinator to EPA. The Group's project coordinator will also prepare status update reports for submission to EPA prior to the Group's monthly conference calls with EPA.

SECTION 7.0
SCHEDULE

Due to EPA's deadline for preparing and issuing the Five-Year Review Report, the Group will attempt to complete the work on an expedited schedule. The Group's project coordinator will provide periodic schedule updates to the EPA and Illinois EPA project managers as the work is completed. Also, the Group's project coordinator will notify the EPA and Illinois EPA project managers as soon as any of the field work and sampling schedules are defined so that EPA and Illinois EPA will have adequate time to plan and conduct oversight, if desired.

At the present time, the Group does not know whether any monitoring wells at the site will require repairs, replacement, or significant well redevelopment by subcontractors (Section 3.3 and Section 3.4). Therefore, the Group is currently unable to define the overall schedule for completing the work. Because of this uncertainty, the Group's project coordinator will contact the EPA and Illinois EPA project managers after the field reconnaissance and monitoring well assessment (Section 3.2) have been completed to discuss the findings, next steps, and scheduling for subsequent activities and the groundwater sampling event.

The Group currently anticipates that laboratory testing of the groundwater samples will be completed within about two weeks following receipt of the samples at the laboratory. The Group also currently anticipates that preliminary data will be received from the laboratory within about one week after the laboratory testing has been completed. The Group's project coordinator and the contractor's project manager will attempt to discuss the preliminary data with the EPA and Illinois EPA project managers as soon as possible following receipt of the preliminary data. During that discussion, the schedule for completing data validation and for preparing a final report will be reviewed.

SECTION 8.0
REFERENCES

ARCADIS Geraghty & Miller, Inc., Final Pre-Design Investigation Work Plan for Groundwater, August 2000.

ARCADIS Geraghty & Miller, Inc., Groundwater Monitoring Plan, NL Industries/Taracorp Superfund Site, Granite City, Illinois, September 2001.

ARCADIS Geraghty & Miller, Inc., Monitoring Well Abandonment Report, NL Industries/Taracorp Superfund Site, Granite City, Illinois, September 2005.

U.S. Environmental Protection Agency, Decision Document/Explanation of Significant Differences, September 1995.

LIST OF FIGURES

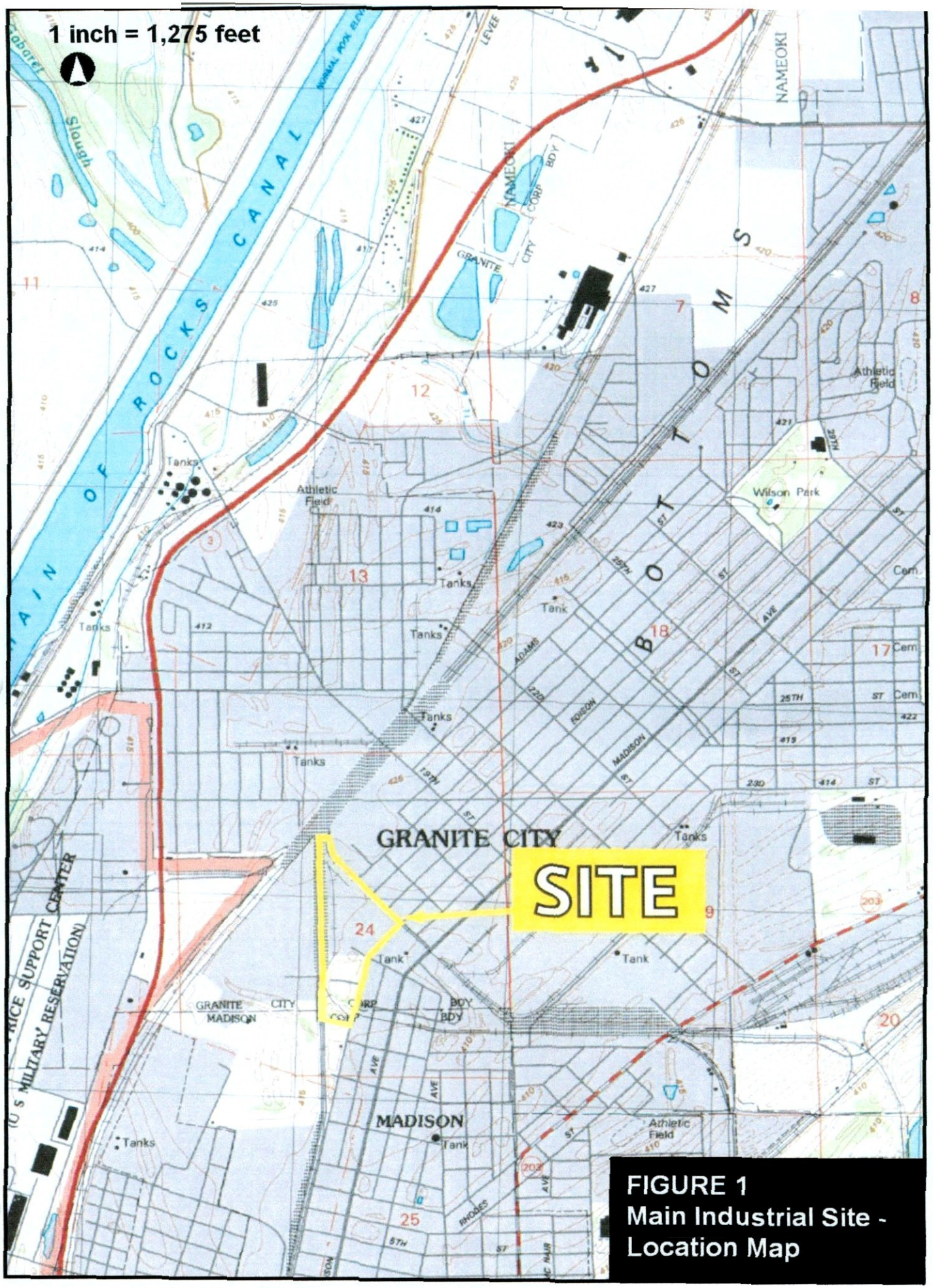

FIGURE 1
Main Industrial Site - Location Map

FIGURE 2 - MAIN INDUSTRIAL SITE

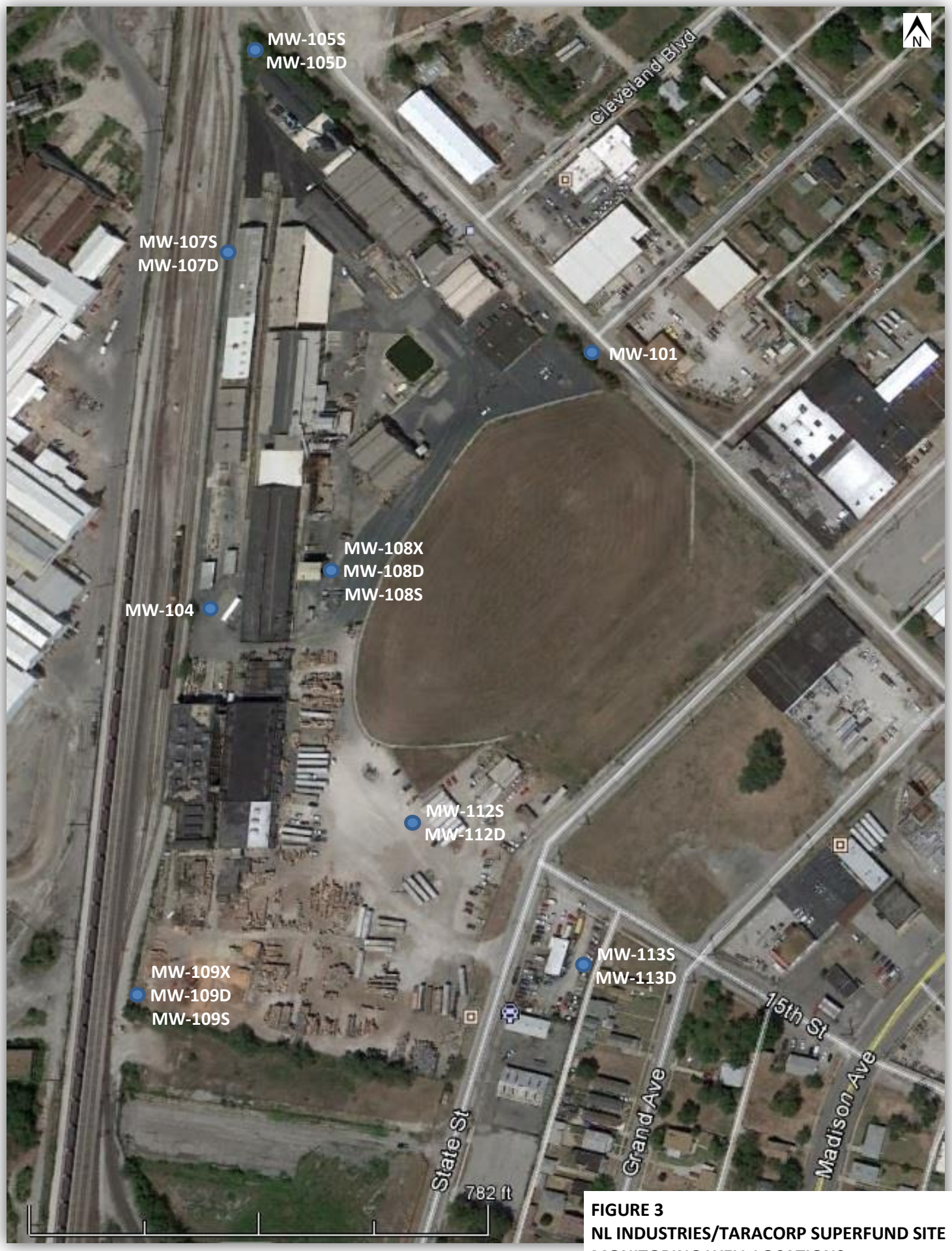

FIGURE 3
NL INDUSTRIES/TARACORP SUPERFUND SITE
MONITORING WELL LOCATIONS

LIST OF APPENDICES

Appendix 1	**Site-Specific Health and Safety Plan (Prepared by ARCADIS Geraghty & Miller, Inc. as part of the August 2000 Final Pre-Design Investigation Work Plan for Groundwater)**
Appendix 2	**Monitoring Well Construction Details**
Appendix 3	**Excerpts from Groundwater Monitoring Plan (Prepared by ARCADIS Geraghty & Miller, Inc. as part of the September 2001 Groundwater Monitoring Plan)**
Appendix 4	**Quality Assurance Project Plan (Prepared by ARCADIS Geraghty & Miller, Inc. as part of the August 2000 Final Pre-Design Investigation Work Plan for Groundwater)**
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Appendix 1

SITE-SPECIFIC HEALTH AND SAFETY PLAN

(Prepared by ARCADIS Geraghty & Miller, Inc. as part of the August 2000 Final Pre-Design Investigation Work Plan for Groundwater)

ARCADIS GERAGHTY & MILLER

Pre-Design Investigation Work Plan For Groundwater
NL Industries/Taracorp Superfund Site
Granite City, Illinois

APPENDIX C

Site-Specific Safety and Health Plan

ARCADIS Geraghty & Miller, Inc.
35 East Wacker Drive, Suite #1000
Chicago, Illinois 60601

REPORT

September 1999

PRE-DESIGN INVESTIGATION WORK PLAN FOR GROUNDWATER
NL INDUSTRIES/TARACORP SUPERFUND SITE
GRANITE CITY, ILLINOIS

APPENDIX C

SITE-SPECIFIC SAFETY AND HEALTH PLAN

	Approval	*Date*
Consultant Project Manager	ARCADIS Geraghty & Miller, Inc.	
Consultant Corporate Health & Safety Officer	ARCADIS Geraghty & Miller, Inc.	
Consultant Office Health & Safety Officer	ARCADIS Geraghty & Miller, Inc.	
Consultant Site Safety Officer	ARCADIS Geraghty & Miller, Inc.	

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Section Title Page

ATTACHMENTS

ARCADIS GERAGHTY & MILLER

PROJECT NAME: NL Industries/Taracorp Superfund Site

PROJECT LOCATION: Granite City, Illinois

CLIENT: NL Industries/Taracorp Site Group

SITE DESCRIPTION:

The NL Industries/Taracorp Site is located in a heavily industrialized section of Granite City, Illinois, across the Mississippi River from St. Louis, Missouri.

WORK DESCRIPTION:

- Evaluate the condition of existing monitoring wells at the Main Industrial Site by redevelopment to achieve sediment free water. Wells that cannot be redeveloped will be replaced.
- Installation of additional well clusters, one on-site and four off site.
- Install two new wells at Clusters MW-108 and MW-109.
- Installation of three shallow wells at each of the remote sites.
- Collect two rounds of groundwater samples from the existing monitoring well network and the supplemental wells.
- Perform laboratory testing on soil samples to determine the cation exchange capacity of the soil.
- Conduct hydraulic conductivity testing in the shallow aquifer.

WORK SCHEDULE: Fall 1999

PRIME CONTRACTOR: ARCADIS Geraghty & Miller, Inc.

PROJECT MANAGER: Jack Kratzmeyer

H & S COORDINATOR: Laura Lynn Ormsby

SITE SAFETY OFFICER: To be named

1.0 Introduction

This Site Site-Specific Safety and Health Plan (SSHP) has been prepared for use at the NL Industries/Taracorp Site in Granite City, Illinois. The elements of the SSHP are based upon requirements described in the United States Environmental Protection Agency (U.S. EPA) Standard Operating Safety Guide and the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Standards contained in 29 CFR 1910. Guidelines provided by the above resources have been supplemented by previous studies and site visits. All reasonable precautions shall be taken to protect the safety and health of workers and general public. All work will be performed in accordance with applicable Federal, State, and local regulations.

The objective of this SSHP is to provide safe on-site working conditions during the NL Industries/Taracorp Pre-Design Investigation field activities. The protection of workers and environmental safety and health issues are primary concerns which will be addressed during this project. The procedures established in this SSHP are based on an analysis of potential hazards, and personnel protection measures which have been selected in response to these potential hazards.

2.0 ARCADIS Geraghty & Miller Responsibility

ARCADIS Geraghty & Miller will be responsible for the adherence of its personnel to the Site-Specific Safety and Health Plan while performing field activities. All work will be performed in accordance with the health and safety requirements described herein, the current edition of the Standard Operating Safety Guides prepared by the U.S. EPA Office of Emergency and Remedial Response, Hazardous Response Support Division, and all Federal OSHA, State, and local health and safety regulations. (ARCADIS Geraghty & Miller will be responsible for the adherence of its subcontractors and site visitors to this SSHP during performance of the Pre-Design Investigation, and will make copies available for their review upon request.)

The project manager is ultimately responsible for all project participants abiding by the requirements outlined in this Site-Specific Safety and Health Plan. The health and safety coordinator (HSC) will provide technical coordination and support of the health and safety program. The HSC will act in an advisory capacity to the site safety officer (SSO).

A SSO will be assigned to the project for the duration of field investigation studies. The SSO is responsible for field implementation and enforcement of the SSHP. The SSO must conduct health and safety meetings with field personnel prior to any field activities, and provide all related documentation. Daily surveillance and monitoring will be conducted to verify proper SSHP implementation. The SSO will be familiar with all drilling and installation techniques, and sampling procedures. In addition, the SSO will be currently certified in First Aid/CPR by the American Red Cross or an equivalent agency.

The SSO will stop field activities work if worker or public health are threatened by site operations, and may implement safety requirements in addition to those described herein on a case-by-case basis. The SSO, HSC, and Project Manager will take action to re-establish safe working conditions and safeguard site personnel, the public, and environment should an unforeseen or site-specific safety related factor, hazard, or condition become evident during investigation activities.

3.0 Site Characterization

3.1 Physical Location and Description

The NL Industries/Taracorp Site is a former lead-acid battery breaking and secondary lead smelting facility located in Granite City, Illinois. Metal refining, fabricating, and associated activities had been conducted at the Site since the late-1800's, and secondary lead smelting had been performed since 1903. The Site consists of three general areas: the Main Industrial Site, the Remote Fill Areas (Eagle Park Acres and Venice Township) and residential areas. The residential areas are not impacted by the scope of work herein and are not addressed by this plan. The Main Industrial Site is approximately 18-acres and consists of the original facility, while the remote fill locations consist of two residential areas, Venice Township and Eagle Park Acres. Venice Township and Eagle Park Acres are 130 acres and 1.8 acres, respectively.

Granite City, Illinois is located in the St. Louis, Missouri metropolitan area, which has a population of approximately 2.5 million people. Granite City has a population of approximately 40,000, and lies in the Mississippi River Valley. The Mississippi River is located approximately 2 miles to the west of the Site and the Chain of Rock Canal is 1-1/2 miles to the west-northwest of the Site.

Underlying the Site is the American Bottoms aquifer, which is a sand and gravel aquifer. The site is not located within the boundaries of the 100 year flood plain. The soils in the area belong to the Riley-Landes-Parkville Association, which consists of silty clay loam, silty clay, and fine sandy loam.

Operations at the smelting facility ceased in 1983. Lead concentrations have been observed in surface soils at on-site and off-site locations (IEPA 1983). The off-site locations include properties surrounding the Site, and properties south of the Site, where hard rubber from battery cases was used as fill and paving material.

An on-site pile, which has recently been capped contains slag, lead bearing materials in 55-gallon drums, and plastic and hard rubber from battery cases, and other lead containing materials. Samples of these materials exhibited elevated lead concentrations and other heavy metals which are associated with the secondary lead smelting industry. Off-site locations include fill materials that were reportedly generated at the smelting facility.

3.2 Nature and Extent of Wastes

Constituents of concern at the site include lead, cadmium, iron, manganese, and zinc. The presence of these metals was identified in the Remedial Investigation and the Feasibility Study. Table 1 presents a list of the highest constituent concentrations observed in groundwater samples collected from the Site.

The Site has been the subject of several previous environmental investigations. Groundwater concentrations above the Illinois Class I and Class II groundwater protection standards have been reported for certain metals in the data from these prior investigations. Additional groundwater sampling will be performed as part of the present Pre-Design Investigation to verify the results of previous groundwater investigations, and to determine the lateral and vertical extent of any impacted groundwater.

4.0 Potential Hazard and Risk Evaluation

Constant attention shall be given to protecting on-site personnel from the chemical and physical hazards that may be encountered during pre-design investigation activities. An evaluation of potential hazards is based on site history, existing analytical data from previous investigations, and the planned site activities.

4.1 Planned Site Activities

The investigation field activities at the site will consist of the following:

- Evaluate the condition of existing monitoring wells at the Main Industrial Site and redevelop the wells using a surge block to achieve sediment free water. Wells that cannot be redeveloped will be replaced.
- Install five (5) supplemental well clusters (shallow and intermediate depths) at or near the Main Industrial Site.
- Install two deep wells at the existing monitoring well clusters MW108 and MW109.
- At each of the remote fill sites (Eagle Park Acres and Venice Township) install three (3) shallow monitoring wells.
- Collect up to twenty (20) soil samples from the shallow, intermediate and deep wells for cation exchange capacity testing.
- Collect two (2) rounds of groundwater samples from the entire monitoring well network for laboratory analysis of selected inorganic parameters.
- Conduct in-situ aquifer (i.e., slug) testing at selected on-site monitoring wells to evaluate the hydraulic conductivity of the shallow aquifer.

A site location map, which illustrates the locations for the planned site activities, is included as Figure 1.

4.2 Chemical Hazards

The characteristics of the constituents of concern at the NL Industries/Taracorp Site are described in Attachment C-1.

The following potential chemical exposure routes and hazards which may be encountered during field work at the site are listed below:

- Inhalation and ingestion of metals-contaminated dusts.
- Ingestion of contaminated surface soils (accidental/poor hygiene).
- Ingestion of contaminated groundwater.
- Dermal contact with contaminated water.
- Dermal contact with contaminated equipment and structures.

These hazards will be minimized by following the protocol for the designated working level of personal protection as described in Section 5.0, Personnel Protection Program.

4.3 Physical Hazards

The physical hazards which may be encountered during the planned field activities described above include:

- Noise Exposure
- Climbing Hazards
- Lifting Hazards
- Lacerations and Contusions
- Heat Stress
- Cold Injury
- Underground Utilities Hazards

- Explosive Hazards
- Steam Burns
- Heavy Equipment Hazards

General considerations for these common physical hazards are discussed in the following sections.

4.3.1 Noise Exposure

The field team will be exposed to excessive noise levels from drilling equipment. Drill rigs typically exceed the 85 dBA (decibels on the A scale) average, yet monitoring for a particular noise level will not be performed. Hearing protection will be worn while drilling activities are being performed. The SSO will determine the extent of hearing protection which is required based on situation-specific conditions.

4.3.2 Climbing Hazards

In the course of the sampling activity, subcontractors may have to climb on the equipment, or may have to climb over such items as inclines or mounds to obtain access to some areas. The drilling subcontractor will only perform climbing activities which conform with any applicable NIOSH and OSHA requirements.

4.3.3 Lifting Hazards

Subcontractors may be exposed to injury caused by lifting heavy objects. Drilling operations can involve manual movement of drilling casing, auger flights, and various other pieces of equipment. All field team members will be trained on the proper method used to lift heavy equipment and cautioned against lifting objects that are too heavy for one person.

4.3.4 Lacerations and Contusions

The field team may cut or bruise themselves while conducting tasks associated with this project. Drilling and sampling activities usually involve contact with moving machinery and physical objects. A first aid kit must be present onsite, allowing personnel to disinfect and bandage minor cuts and bruises. These first-aid materials will be sealed in individual packages, stored in a weatherproof container, and periodically inspected for completeness.

Serious contusions may result from falling objects, flying objects, or being caught between idle or moving pieces of machinery. Care will be taken to avoid these situations when working with heavy equipment. Hard hats will be used by all personnel performing field work.

4.3.5 Heat Stress

During this project, workers may be required to wear protective clothing which insulates the body. If heavy work is performed under high air temperatures, heat stress may to occur, especially when the protective clothing inhibits the body's ability to cool itself. Both heat exhaustion and heat stroke may occur. Heat-related stress is described in Section 6.2.1, Heat Stress Monitoring.

4.3.6 Cold Injury

Prolonged exposure to excessive cold or wet conditions may cause loss of body heat (hypothermia) and/or frostbite. Ambient air temperature and wind velocity are two factors which influence the development of cold weather injuries. Cold-related stress is described in Section 6.2.2, Cold Stress Monitoring.

4.3.7 Underground Utilities

Whenever the ground is penetrated, the potential for cutting into utilities exists. A ARCADIS Geraghty & Miller representative will consult with facility engineers and local authorities about the location of underground utility lines (water, gas, electrical, telephone, cable television, etc.) during the planning/mobilization phase. Prior to the start of any field activities, utility lines will be clearly delineated in the selected area for work. All field personnel and workers will be explicitly informed of utility line locations.

4.3.8 Explosive Conditions

Explosive conditions can develop as a result of releasing volatile substances from subsurface materials; however, volatile constituents are not expected to be encountered at the Site.

4.3.9 Steam Burns

Steam cleaning associated with decontamination procedures pose potential hazards to the skin. Steam burns are a potential skin hazard, therefore protective clothing will be worn during steam cleaning activities. Personnel who perform steam cleaning will wear appropriate protective equipment, as determined by the SSO.

4.3.10 Heavy Equipment Hazards

The operation of heavy equipment can pose many slip, trip and fall hazards. The operator is generally responsible for safe operation of the equipment; however, personnel and site visitors must be aware of safety considerations associated with heavy equipment. Only properly trained personnel may operate heavy equipment. Personnel and visitors must take care to stand at an appropriate distance from equipment. Refer to Section 8.2 regarding drilling operations safety which addresses additional safety requirements.

4.4 Biological Hazards

Potential biological hazards that may be encountered during site work include, but are not limited to, insect bites/stings (including tick bites), animal bites, and snake bites. All field team members will be properly briefed regarding the potential for encountering wildlife, as well as prompt first aid procedures in the event of an insect, animal, or snake bite. Personnel will wear appropriate protective gear (e.g., long-sleeved shirts and heavy socks pulled over pants) to minimize the potential for bites and/or stings.

5.0 Personnel Protection Program

A Personnel Protection Program has been established and will be maintained for all ARCADIS Geraghty & Miller personnel working at the site. ARCADIS Geraghty & Miller will provide any necessary safety and health training to its personnel. All subcontractors shall be health and safety trained pursuant to 29 CFR 1910.120 regulations.

5.1 Training Requirements

Prior to the commencement of any field work, an orientation will be conducted by the Site Safety Officer. This session will take place at the site prior to the start of work and will include, but is not limited to the following topics:

- Site history
- Scope of field work
- Specific hazards (toxicological data, heat stress/exposure, other physical hazards)
- Hazard recognition
- Standard operating procedures (including no smoking, no contact lenses, and no hand-to-mouth contact within any designated exclusion zones prior to completing decontamination procedures)
- Potential respirator use
- Decontamination (personnel and equipment)
- Emergency procedures

The Health and Safety Meeting Form is shown in Figure 2 and will be completed at the conclusion of each orientation session.

All ARCADIS Geraghty & Miller personnel and subcontractors must meet OSHA requirements outlined in 29 CFR 1910.120, which covers hazardous waste operations and emergency response. All field personnel must attend eight hours of annual refresher training in addition to the 40-hour training program, and new employees must

perform three days of work activity under the supervision of a trained and experienced work supervisor. Documentation confirming these requirements will be retained at the field office of the SSO for reference.

5.2 Levels of Personal Protection

All drilling, well installation, and groundwater sampling activities will initially be performed in Modified Level D PPE.

Modified Level D

Modified Level D PPE is worn during activities which do not suggest a need for any initial respiratory protection, but when dermal protection is warranted. The equipment to be worn includes:

- work clothing as prescribed by weather
- Tyvek™ or poly-coated Tyvek™ coveralls (chemical resistant)
- steel-toed, steel shank boots (chemical resistant)
- hard hat
- safety glasses
- inner gloves: surgical type
- outer gloves: nitrile for situations of expected constituent concentrations,
  SilverShield for situations of unverified site conditions
- disposable booties
- hearing protection (if necessary)

While to expected to become necessary, Level C protection may be implemented at the discretion of the SSO in cases of extreme weather that may result in the airborne migration of constituents of concern.

Level C

Level C is to be worn when dermal absorption or damage is possible and respiratory protection is necessary. Level C PPE includes:

- work clothing as prescribed by weather
- Tyvek™ or saranac coveralls
- steel-toed, steel shank boots (chemical resistant)
- hard hat
- inner gloves: surgical type

- outer gloves: nitrile for situations of expected constituent concentrations,
  SilverShield for situations of unverified site conditions
- outer boot covers
- full-face respirators with appropriate cartridges
- hearing protection (if necessary)

The respiratory protection program for Level C includes the use of a NIOSH and OSHA-approved full-face respirator with appropriate cartridges. The MSA™ Cartridge Model F will be sufficient should Level C respiratory protection be required. Level C work will always be done using the "buddy system." Respirators, if used, will be cleaned on a daily basis using clean, warm water and MSA™ Clean-Sanitizer. In addition, when respirators are used, the cartridges shall be replaced on a daily basis or more often if deem necessary by the HSC

5.3 Limitations of Protective Clothing

The designated PPE has been selected to provide protection against potential constituents and physical hazards. However, no protective garment, glove, or boot is chemical proof, nor can it provide protection against all chemical types. Chemical permeation through the PPE is governed by constituent concentrations, environmental conditions, physical conditions of the protective garment, and resistance of the garment to specific constituents.

To obtain optimum performance from the PPE, the following procedures should be followed.

- When using coveralls, don a clean, new, garment after each rest break and at the beginning of each shift.
- Inspect all clothing, gloves, and boots prior to use for imperfect seams, non-uniform coating, tears, or poorly functional closures.
- Inspect reusable garments, boots, and gloves prior to, and during use, of visible signs for chemical permeation, swelling, discoloration, stiffness, brittleness, cracks, punctures, and any signs of abrasions.

Discard reusable garments, boots, or gloves exhibiting any of the aforementioned characteristics. In areas known to exhibit elevated concentrations of constituents, PPE will not be reused.

5.4 Decontamination Procedures

Decontamination is the process of removing or neutralizing constituents from personnel or equipment. The decontamination process will prevent the migration of potentially harmful materials into unaffected areas. Decontamination also protects the worker from constituents that have accumulated on PPE, tools, and other equipment. Appropriate decontamination procedures will be followed by all personnel performing work tasks in an exclusion zone which will be discussed in Section 7.1, regardless of the work task or protection level used. Personnel will also follow proper decontamination procedures prior to leaving the decontamination zone. The following sections describe the decontamination procedures to be followed during field activities.

5.4.1 Modified Level D Decontamination

The general decontamination procedures for workers in Modified Level D conditions are described in the section below.

Station 1: *Equipment Drop*

Equipment used onsite (tools, sampling devices, and other potentially contaminated equipment) are left in the exclusion zone or on the drill rig during drilling activities.

Station 2: *Gloves and Outer Garment Removal*

Outer gloves will be scrubbed with the proper decontamination solution (Micro™, and distilled water) or disposed of in plastic bags; inner gloves will be disposed of in plastic bags. Steel-toed boots will also be scrubbed with decontamination solution, if required. Outer garments (Tyvek, disposable booties) are removed at this station and deposited in plastic bags which will be stored in drums onsite pending laboratory analyses of sampled media. Hands and face should be washed as soon as possible.

5.4.2 Level C Decontamination

Although not expected, the full decontamination procedures for workers wearing Level C Protection are described in the sections below.

Station 1: *Segregated Equipment Drop*

Deposit equipment used onsite (tools, sampling devices and containers, monitoring instruments, radios, clip boards, etc.) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination.

Equipment:
- Various size containers
- Plastic liners
- Plastic drop cloths

Station 2: *Wash and Rinse Boots and Gloves*

Scrub outer boots and gloves with the proper decontamination solution (detergent/water). Rinse gloves and boots with hand pump spray bottle into plastic bucket.

Equipment:
- 2 containers (30-50 gallon)
- Hand spray pump device (garden sprayer)
- Water
- Detergent
- Scrub brushes

Station 3: *Outer Boot and Glove Removal*

Remove outer boots (if worn) and gloves with accompanying tape. Tape should be placed in a container with a plastic liner.

Equipment:
- 1 container (30-50 gallon)
- Plastic liners
- Bench

Station 4: *Cartridge Change*

If a worker leaves the exclusion zone only to change a cartridge on his/her respirator, this is the last step in the decontamination procedure. Once the worker's cartridge is exchanged, the outer glove and boot covers are donned with joints taped. The worker may then return to the exclusion zone.

Equipment:
- Respirator cartridges
- Tape
- Extra gloves
- Boot covers (if worn)

Station 5: *Boots, Gloves and Outer Garment Removal*

Removal of boots, gloves (inner) and outer garment. The outer chemically resistant garment should be deposited in a plastic lined container.

Equipment:
- Container (30-50 gallon)
- Bench or stool
- Plastic liners

Station 6: *Respiratory Protection Removal*

Remove the face piece respirator, deposit used cartridges in a plastic lined container and wipe the face piece with clean water and paper towels.

Equipment:
- Container (30-50 gallon)
- Plastic liners
- Paper towels
- Detergent solution
- Rinse water

Station 7: *Field Wash*

Wash hands and face.

Equipment: Water
Soap
Wash basin/buckets

5.4.3 Equipment Decontamination

Decontamination of equipment will consist of preliminary removal of gross contamination, using a brush and Alconox® detergent solution, and then rinsing with distilled water. All split-spoons, augers, and all other down-hole drilling/sampling equipment are to be thoroughly steam cleaned between use at different drilling locations. Steam cleaning will be conducted in a designated decontamination area. Large equipment (e.g., drilling rig, etc.) remaining on site, except down-hole drilling equipment, will not be decontaminated, but will be stored in the decontamination station at the end of each day.

6.0 Medical and Environmental Surveillance

6.1 Health Monitoring

ARCADIS Geraghty & Miller has developed a health monitoring program in order to detect potential impacts resulting from exposure to chemicals. All ARCADIS Geraghty & Miller and subcontractor personnel involved with the NL Industries/Taracorp Site will have undergone a yearly physical examination as required in 29 CFR 1910.120(f). ARCADIS Geraghty & Miller employees are furnished with results of the medical examination and the physician's recommended limitations upon employees' assigned work. ARCADIS Geraghty & Miller employees receive yearly physicals consisting of the following:

- Personal, family and environmental history
- Hands-on physical examination
- Snellen's eye examination
- Pap Smear (females over age 21)
- Hemoccult testing (over age 40)
- Pulmonary Function Test
- Audiometric Testing
- Electrocardiogram (EKG)
- Laboratory Testing
- Complete Blood Count
    - Red Blood Count
    - White Blood Count
    - Differential Screening
    - Hemoglobin
    - Hematocrit
- Urinalysis
    - Sugar
    - Albumin
    - Specific Gravity
    - Microscopic

- Laboratory Chemistries

  - A.G. Ratio
  - Albumin
  - Alkaline, Phosphatase
  - Bilirubin, Total
  - Calcium
  - Chloride
  - Cholesterol
  - Creatinine
  - GGT
  - Globulin
  - Glucose
  - Iron
  - Lactic Dehydrogenase (LDH)
  - Phosphorus
  - Potassium
  - Protein, Total
  - SGOT
  - SGPT
  - Sodium
  - Triglycerides
  - Urea Nitrogen (BUN)
  - Uric Acid
  - Blood Lead Level
  - Cadmium
  - Mercury
  - Zinc Protoporphyrin

6.2 Weather-Related Stress Control and Monitoring

Weather conditions from a radio will be monitored periodically by designated field personnel.

6.2.1 Heat Stress Monitoring

If heavy work is performed in conditions with high air temperatures, heat stress is likely to occur, especially when protective clothing inhibits the body's ability to cool itself. Heat stress is caused by several interacting factors, such as environmental conditions, clothing, work load, physical condition, characteristics of the employee, and type of PPE required for the work task. Heat stress may be of concern when dry bulb air temperature exceeds 70 degrees Fahrenheit (°F). Both heat exhaustion and heat stroke may occur. Though less severe than heat stroke, heat exhaustion is indicated by symptoms such as pale and moist skin, heavy sweating, headache, nausea, dizziness, and vomiting. Heat stroke, which is life-threatening, has symptoms of hot, red skin, very small pupils, very high body temperature, and a cessation of sweating.

To protect workers from heat stress, personnel must be monitored for the signs of heat stress. Also, the SSO must provide appropriate liquids for employees, and verify that employees are drinking more than the amount required to satisfy thirst. During hot weather, rest periods will be provided as needed to allow personnel to cool down. Rest periods should be taken as needed in a shaded area if possible and employees should remove protective clothing. Additional details on the monitoring, prevention and aid for heat stress are included in Attachment C-2.

6.2.2 Cold Stress Monitoring

Excessive loss of body heat (hypothermia) and/or frostbite may be caused by prolonged exposure to excessive cold or wet conditions. The first cold weather-related injury is frostbite. Areas of the body which have high surface area-to-volume ratios such as fingers, toes, and ears are most susceptible to frostbite. Three categories of frostbite exist. Frost nip, or incipient frostbite, is characterized by a blanching or whitening of the skin. In the case of superficial frostbite, the skin has a waxy or white appearance and is firm to the touch, though the tissue beneath is resilient. Deep frostbite, which is an extremely serious injury, results in tissues that are cold, pale, and solid.

The second type of cold weather-related injury is hypothermia. The symptoms of systemic hypothermia, which is caused by exposure to freezing or rapidly dropping temperatures, are exhibited in five stages: 1) shivering, 2) apathy, listlessness, and sleepiness, 3) unconscious, glassy stare with a slow pulse and slow respiratory rate, 4) freezing of the extremities, and 5) death.

Persons exposed to temperatures at or below freezing or wind-chill temperatures of 10 °F may experience weather-related injuries in the forms of the previously described frostbite and hypothermia. The two factors that influence the development of a cold injury are ambient temperature and wind velocity. The term "wind chill" describes the chilling effects of moving air in combination with low temperatures. For example, 10 °F with a wind velocity of 15 miles per hour (mph) is the equivalent in chilling effect of still air at -18 °F. In general, the greatest incremental increase in wind velocity occurs when a wind of 5 mph increases to 10 mph. Thus the dangers of cold-related stress on a cold, windy day is greater than on a cold day with little or no wind. Further, water conducts heat 240 times faster than air. Thus the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration-soaked. The SSO will assess site-specific weather conditions to determine if it is appropriate for the site workers to remove protective clothing outdoors.

To minimize cold weather-related stresses, site workers should wear thermal socks, long cotton or thermal underwear, hard hat liners and other cold weather gear. Also, blankets, warm drinks other than caffeinated coffees, and warm break areas are essential. Finally, personnel must be briefed on the dangers of frostbite and hypothermia. Self-monitoring and co-worker monitoring will be highly encouraged.

Given the project schedule, cold weather is not expected within the timeframe for our field investigation activities. However cold-weather related stresses become a pertinent issue, the SSO will develop and communicate an appropriate work/rest schedule and enforce appropriate precautions.

6.2.3 Other Weather-Related Stresses

Serious hazards may result from adverse weather. The ARCADIS Geraghty & Miller SSO may decide to discontinue drilling or other field activity because of severe and threatening weather conditions including lightning, strong winds, heavy rain, and very hot temperatures.

6.3 Breathing Zone Monitoring

No breathing zone monitoring will be conducted because no volatile organic exposures are anticipated during the project.

7.0 Site Control

7.1 Work Zones

Site control will be maintained through the establishment of work zones to prevent exposure to and spread of contamination by activities at the site. Prevention of exposure to and spread of contamination by activities at the site will be achieved through the establishments of work zones. Three work zones will be used: 1) exclusion zone, 2) constituent reduction zone (CRZ), and 3) support zone. The establishment of the work zones (and control lines) will be determined by the SSO, as not all work activities will require an exclusion or constituent reduction zone.

The exclusion zone is the area where the intrusive sampling activities are conducted and where constituents and physical hazards are potentially present. The exclusion zone also includes areas in the immediate vicinity of heavy equipment. The level of protection in this area for the Pre-Design Investigation is Modified Level D. The purposes of specifying this zone are to limit the spread of constituents to clean areas and provide for the safety of those persons not authorized to enter the zone. Only properly trained individuals who are wearing appropriate personal protection equipment will be allowed to enter and work in this zone. The size of the exclusion zone will be established by the SSO based on site-specific conditions and will generally include the immediate working zone around the well installation or sampling areas.

The corridor between the exclusion zone and the support zone is the contamination reduction zone. The contamination reduction zone serves as a buffer to further reduce the possibility of the support zone becoming contaminated. It provides additional assurance that the physical transfer of contaminated substances onto people, equipment, or in the air is limited through a combination of decontamination, distance between exclusion and support zones air dilution, zone restrictions, and work functions. The corridor will contain decontamination stations as described in Section 6.4, Decontamination Procedures.

The support zone is defined as the area outside the zone of potential contamination. The support zone is the staging area for project related personnel, material, and equipment proximate to the area of field operations. In addition, the area serves as a storage area for uncontaminated safety and work equipment. Finally, this zone is used as an area for rest breaks, the consumption of food and beverage, and all activities that serve in a supportive role to the investigating team.

7.2 Site Visitor Protection

Visitors to the site will be instructed to remain outside of the work area. Visitors will be cautioned to avoid skin contact with contaminated or suspected contaminated surfaces. During visitation, hand-to-mouth transfers will be reduced with special precautions not to eat, drink, smoke, or chew gum or tobacco. The use of alcohol prior to or during site visitation is prohibited. Authorized visitors on medication should request prior approval from the acting SSO before entering the site.

Authorized visitors requiring observation of the field activities must read the SSHP and sign a form stating that they have read and understand the safety protocol and will abide by it (Figure 3). Any visitors entering the work area must wear the appropriate personal protective equipment. Visitor inspection of the exclusion zone or the constituent reduction zone will be done under the approval of the SSO.

7.3 Communication

A personnel alarm system with an adequate means of on- and off-site communication will be installed in accordance with 29 CFR 1910.165. Signals will be distinctive and recognizable as messages to evacuate or perform critical operation. The emergency alarm signal code is as follows.

One Blast ..... Stop Work.
Two Blasts ..... Man down.
Three Blasts ..... Evacuate Immediately.

7.4 Site Security

Access gates will be closed and locked when no one is working in the designated area. Access gates will be marked with the following sign:

HAZARDOUS AREA
AUTHORIZED PERSONNEL ONLY
KEEP OUT
CALL (312) 263-6703 FOR INFORMATION

8.0 Safe Work Practices

8.1 General Work Rules

General safe work practices to be followed by field personnel are presented below.

- Field work will be conducted only during daylight hours unless adequate artificial lighting is provided.
- Eating, drinking, chewing of gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any work area. The entire body should be washed thoroughly as soon as possible after leaving the work site.
- All personnel assigned for on-site activities will be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.
- Field personnel must observe each other for signs of toxic exposure and heat/cold illness. Indications of adverse effects include, but are not limited to:
  - Changes in complexion and skin discoloration;
  - Changes in coordination;
  - Changes in demeanor;
  - Excessive salivation and papillary response; or
  - Changes in speech pattern.
- Personnel must also be conscious of non-visual effects of illness such as headaches, dizziness, nausea, blurred vision, cramps, or irritation of eyes, skin, or respiratory tract.
- If any conditions of explosivity or unusual conditions are observed, exit immediately and contact the SSO or Project Manager.

8.2 Drilling Operations Safety

Field activities which require the use of a drill rig can pose many hazards. The drill crew is generally responsible for the safe operation of the drill rig; however, ARCADIS Geraghty & Miller personnel must be aware of safety considerations. To minimize hazards associated with drilling operations, the following practices should be avoided:

- Standing too close to the rig, especially its moving parts.
- Standing near pipe hoist or rig exhaust.
- Walking on drilling rods or casing, or near the edge of a mud pit.
- Refueling an engine while it is still running or hot.
- Wearing loose fitting clothing.

8.3 Soil and Groundwater Sampling Safety

Soil samples will be collected during the course of the investigation as described in the Work Plan. Project personnel should take precaution to avoid inhalation of soil dusts at all sample locations. Modified Level D PPE will be worn during all routine sampling tasks.

9.0 Emergency Procedures

The following standard emergency procedures will be used by on-site personnel, as shown on Figure 4. The SSO will be notified of any on-site emergencies and will be responsible for following the appropriate procedures. Figure 5 presents an emergency report form which must be completed by the SSO for each instance of employee injury or possible exposure.

9.1 Emergency Phone Numbers and Hospital Location

Emergency phone numbers will be posted in a conspicuous space in the support zone, and are shown in Table 2. Should medical attention be required, the injured person will be transported to the nearest hospital, which is the St. Elizabeth Medical Center.

Written directions to the St. Elizabeth Medical Center are shown in Table 3 for all three sampling locations, as well as the Main Industrial Site, Eagle Park, and Venice Alley. A map with the route to the hospital for each area is shown on Figures 6, 7, and 8. The St. Elizabeth Medical Center is sufficiently staffed and equipped to handle emergency medical cases involving hazardous or toxic substances. The SSO will be responsible for making all field personnel familiar with the location of the hospital, and knowing where the emergency phone list and directions to the hospital are located. Prior to commencement of the field activities, the SSO will locate the nearest telephone or have access to a portable telephone. The field team will be informed of the location and directions to this phone.

9.2 Personnel Injury

In the event of an injury, the SSO will evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to the movement to the support zone. Appropriate first-aid will be initiated, and contact will be made with the St. Elizabeth Medical Center (if necessary). No persons shall reenter the exclusion zone until the cause of the injury or symptoms are determined.

9.3 Personnel Injury in the Support Zone

Upon notification of an injury on the support zone, the ARCADIS Geraghty & Miller Project Manager and SSO will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue; the appropriate first-aid and necessary follow-up as stated above should be initiated.

9.4 Fire/Explosion Emergency Procedures

Fire hazards may exist during field activities. The field team will be prepared to put out small fires with an extinguisher and immediately report the incident to the project manager. A portable fire extinguisher will be located on field vehicles. In the event of a large fire, the field team will contact the appropriate authorities and report the fire. Upon notification of a fire or explosion on the site, all personnel will assemble at the contamination control line or other safe area. The Granite City Fire Department shall be alerted and all personnel moved to a safe distance from the impacted area.

The SSO will check to see that each vehicle and drilling rig fire extinguisher is appropriate for the fire hazard presented by this project. Generally, Type A, B and C extinguishers are appropriate.

The SSO will take the following action in the event of a fire:

- Notify all site personnel and appropriate authorities that a fire exists.
- Shutdown site activities.
- Account for all site workers.
- Evacuate the site if necessary.

9.5 General On-Site First-Aid

- **Contaminated materials get into eyes** - Wash eyes with copious amounts of water for at least 15 minutes. Lift upper and lower lids occasionally. Seek medical attention immediately. An eye wash unit will be provided in the Exclusion Zone at the working area.

- **Contaminated materials contact skin** - Promptly wash area with soap or mild detergent and water. Flush well with water. Check for signs of skin irritation. Seek medical attention if unusual appearance or skin sensation is noted.

- **Contaminated materials penetrate protective clothing** - Discard protective clothing. Wash skin as described above. Confer with Site Safety Officer in selection of new protective clothing.

- **Inhalation of contaminated air** - Move person to well-ventilated area at once. If individual is not noticeably overcome, and has no side effects after about five minutes, return to work is allowed.

- **Ingestion of contaminated materials** - Flush mouth with water, being careful not to swallow. Contact local poison center. When called for, induce vomiting. (DO NOT induce vomiting within unconscious persons). Seek medical attention promptly.

9.6 Emergency Communications

Verbal communications may be difficult at times due to personal protective equipment and noise. A universal set of hand signals will then be used. They are as follows:

Hand gripping throat ..... I can't breathe.
Grip partner's wrist or place hands around waist ..... Leave work area immediately.
Hands on top of head ..... I need assistance.
Thumbs up ..... OK. I am all right.
Thumbs down ..... No. Negative.

TABLES

Table 1. Maximum Concentrations of Constituents of Concern, NL Industries/Taracorp Superfund Site, Granite City, Illinois.

	Maximum Detected Concentrations	
	Remedial Investigation	USEPA Second Addendum to Feasibililty Study
Contaminant	Shallow Wells	Site-Wide
Inorganic Compounds		
Antimony	NA	0.01
Arsenic	0.101	0.091
Cadmium	6.9	11.6
Chromium	NA	1.35
Copper	0.02	0.14
Iron	22	NA
Lead	0.013	1.17
Manganese	29.4	NA
Mercury	NA	0.0015
Nickel	0.94	0.98
Selenium	0.003	ND
Silver	NA	0.012
Thallium	NA	0.136
Zinc	44	44.9

Notes:
Concentrations reported in mg/L.
ND Not detected.
NA Not analyzed.

Table 2. Emergency Telephone Numbers,
NL Industries/Taracorp Superfund Site, Granite City, Illinois.

Agency	Telephone Number
Hospital	
St. Elizabeth Medical Center 2100 Madison Avenue Granite City, Illinois 62040	(618) 288-3300
Fire Department	
Granite City, Illinois	(618) 876-1424
Venice, Illinois	(618) 877-4232
Ambulance	
Emergency	911
Professional Medical Team	911
Police	
Emergency	911
Madison County Sheriff 405 Randle Street Edwardsville, Illinois 62025	(618) 692-6087
Granite City Police Department 2330 Madison Avenue Granite City, Illinois 62040	(618) 451-9760
Venice Police Department Broadway & Klein Venice, Illinois 62090	(618) 877-2144
Poison Control Center	(800) 632-2727
ARCADIS Geraghty & Miller Physician	
EMR	(800) 229-3674
ARCADIS Geraghty & Miller Physician	
Chicago, Illinois	(312) 263-6703
Respondents Representative	
Renato Pasqualoni, Techinal Project Manager Waterloo, Ontario, Canada	(519) 725-3313

Table 3. Directions to Hospital - St. Elizabeth Medical Center, NL Industries/Taracorp Superfund Site, Granite City, Illinois.

From NL Industries/Taracorp Site:

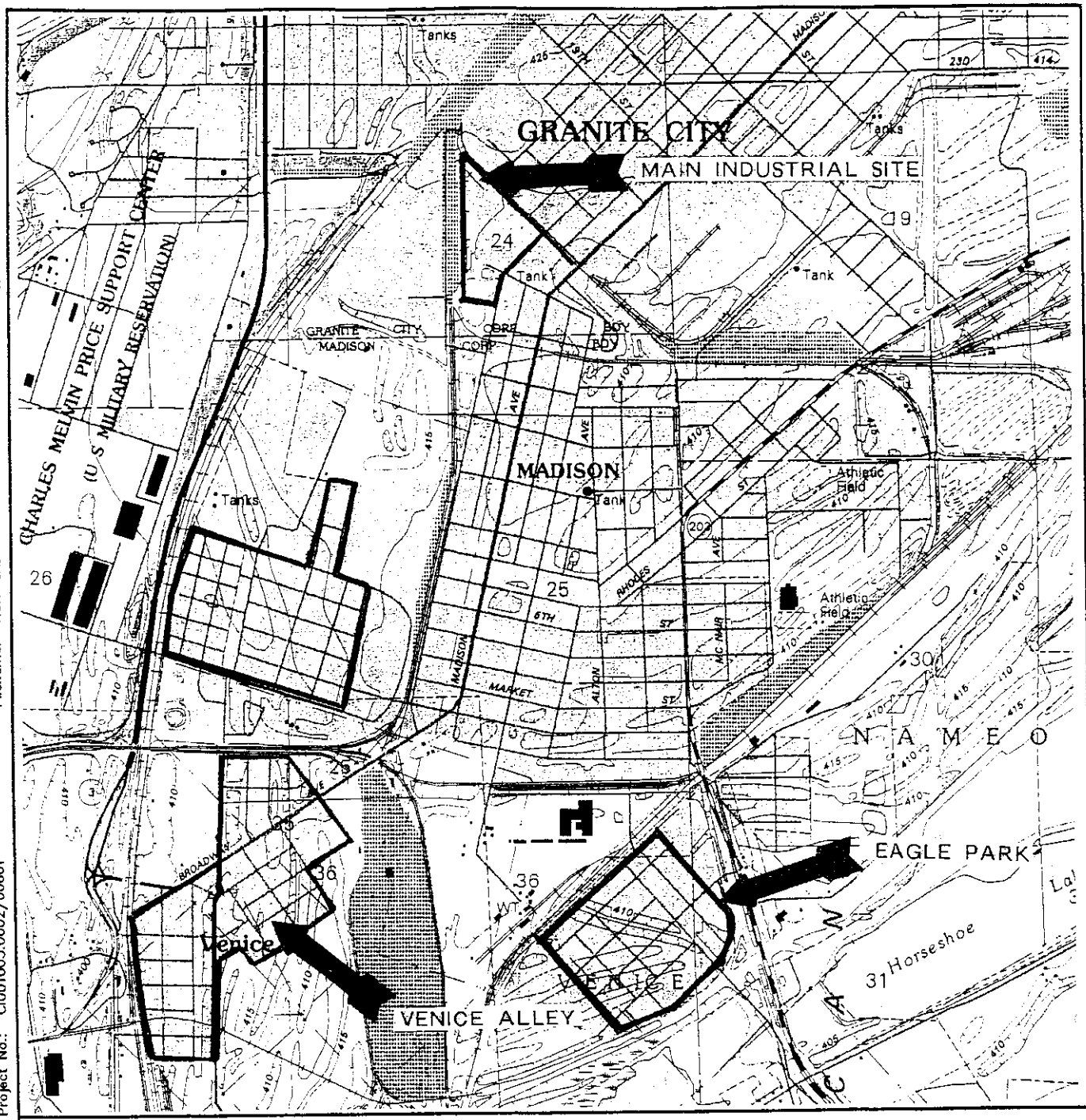
Travel southeast on 16th Street to Madison Avenue. Travel northeast on Madison Avenue for approximately two-thirds of a mile. The St. Elizabeth Medical Center is located on the east (right) side of Madison Avenue. The address of the St. Elizabeth Medical Center is 2100 Madison Avenue. Follow signs to the emergency entrance.

From Eagle Park Acres (remote fill area):

Travel north on McCambridge Avenue (Route 203) for approximately half of a mile. This turns into Edwardsville Road (Route 203) and heads north and then northeast. Follow Edwardsville Road for approximately 1.75 miles until 20th Street. Turn left on 20th Street (heading northwest) until Madison Avenue. Turn right (northeast) onto Madison Avenue. Travel northeast on Madison Avenue. The St. Elizabeth Medical Center is located on the east (right) side of Madison Avenue. The address of the St. Elizabeth Medical Center is 2100 Madison Avenue. Follow signs to the emergency entrance.

From Venice (remote fill area):

Travel northeast on Broadway Avenue for approximately 0.5 miles until Broadway turns into Madison Avenue. Travel northwest on Madison Avenue for approximately 2.5 miles. The St. Elizabeth Medical Center is located on the east (right) side of Madison Avenue. The address of the St. Elizabeth Medical Center is 2100 Madison Avenue. Follow signs to the emergency entrance.



SOURCE: USGS 7.5 MIN. TOPOGRAPHIC MAP, GRANITE CITY, ILLINOIS/MISSOURI QUADRANGLE, 1954, PHOTOREVISED 1993.

Drawn By/Plot Scale: SGozner/1=1
Filename: NON-CAD
Project No.: CI001003.0002/00001
Date: 8/19/99

ARCADIS GERAGHTY & MILLER

35 East Wacker Drive
Suite 1000, Chicago, Illinois 60601
Tel: 312/263-8703 Fax: 312/263-7697

SITE LOCATION MAP
PRE-DESIGN INVESTIGATION WORK PLAN
NL INDUSTRIES/TARACORP
SUPERFUND SITE
GRANITE CITY, ILLINOIS

PROJECT NUMBER: CI1003.002

FIGURE NUMBER: 1

ARCADIS GERAGHTY & MILLER

FIGURE 2

HEALTH AND SAFETY MEETING FORM

NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

SITE _____ CITY, STATE _____

WORK LOCATION AT SITE _____

PREPARED BY _____

PROJECT MANAGER _____ PROJECT MANAGER _____

TYPE OF WORK _____

SAFETY TOPICS PRESENTED

CHEMICAL HAZARDS AND EXPOSURE ROUTES _____

_____

_____

PHYSICAL HAZARDS AT SITE AND HAZARDS RELATED TO TYPE OF WORK _____

_____

_____

PROTECTIVE CLOTHING/MONITORING EQUIPMENT REQUIRED _____

_____

_____ STEEL TOE BOOTS

_____ HARD HAT

_____ SAFETY GLASSES/GOGGLES

_____ SPECIAL EQUIPMENT _____

_____ GLOVES (SPECIFIC TYPE)

_____ TYVEK

_____ RESPIRATOR (Specify Cartridge Selection)

EMERGENCY INFORMATION

AMBULANCE/PARAMEDIC PHONE ( ) HOSPITAL ( ) _____

ROUTE TO HOSPITAL (Attach Map if Necessary) _____

_____

_____

ATTENDEES

MEETING GIVEN BY _____ DATE _____ TIME _____

SIGNATURES _____ _____ _____

_____ _____ _____

NOTE: THE SAFETY MEETING SHOULD BE COMPLETED AS OFTEN AS REQUIRED (DAILY, WEEKLY, WHEN NEW PERSONNEL ARE ON SITE).

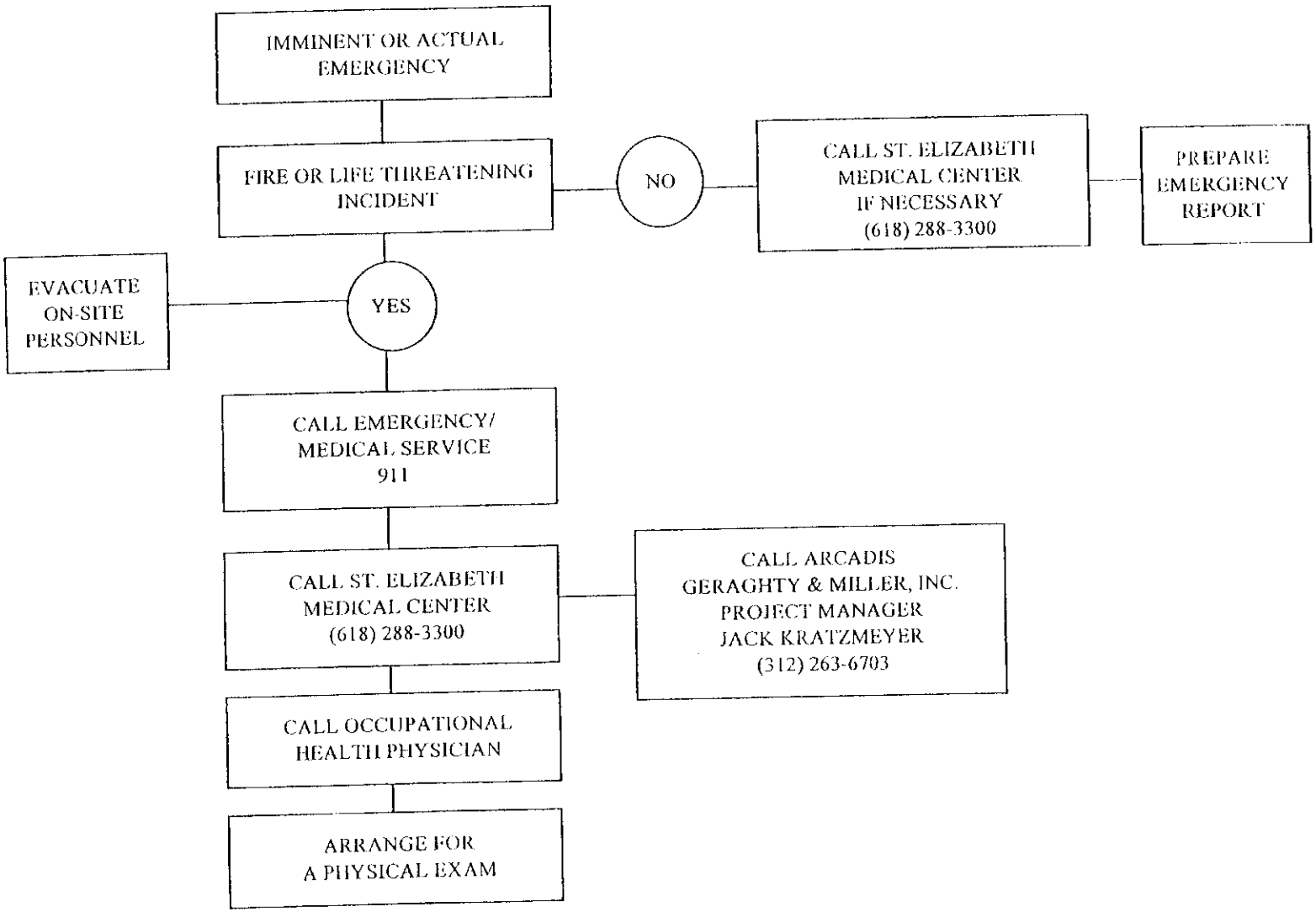
8/95

FIGURE 3

VISITOR REVIEW OF SITE HEALTH AND SAFETY PLAN
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

THE UNDERSIGNED VISITORS OF THE NL INDUSTRIES/TARACORP SITE REQUIRE ENTRANCE TO THE EXCLUSION ZONE AND HAVE THOROUGHLY READ THE HEALTH AND SAFETY PLANS, UNDERSTAND THE POTENTIAL HAZARDS AT THE SITE AND THE PROCEDURES TO MINIMIZE EXPOSURE TO THE HAZARDS, WILL FOLLOW THE DIRECTION OF THE SITE HEALTH AND SAFETY OFFICER, AND WILL ABIDE BY THE HEALTH AND SAFETY PLAN

NAME (PRINT)	COMPANY	DATE	SIGNATURE



ARCADIS GERAGHTY & MILLER

35 East Wacker Drive
Suite 1000, Chicago, Illinois 60601
Tel: 312/263-6703 Fax: 312/263-7897

EMERGENCY RESPONSE PLAN
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

PROJECT NUMBER
CI001003.0002

FIGURE NUMBER
4

FIGURE 5
EMERGENCY REPORT FORM
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

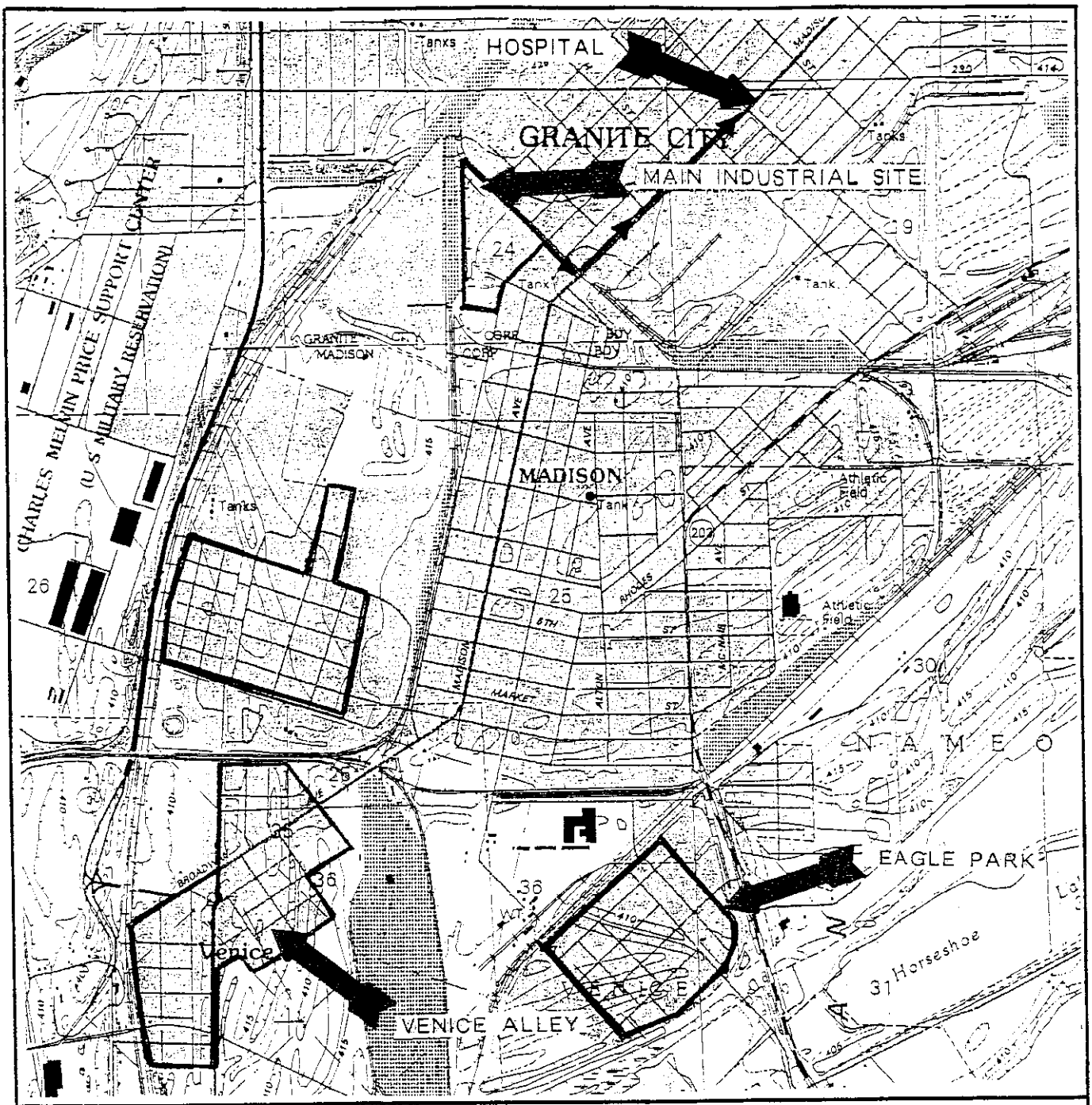
1. DATE_____
2. TIME OF ACCIDENT_____

   CLIMATIC CONDITIONS_____
3. ON-SITE COORDINATOR_____
4. EMPLOYEE INJURED_____
5. COMPANY AFFILIATION_____
6. SOCIAL SECURITY NUMBER_____
7. INSURANCE COMPANY_____
8. NUMBER OF WORKERS AT SITE_____

NAMES OF WORKERS	COMPANY AFFILIATION
1.	
2.	
3.	
4.	
5.	

9. CIRCUMSTANCES OF THE INJURY/EMERGENCY ACTION_____
10. EMERGENCY ACTIONS TAKEN_____
11. WHAT FIRST AID WAS PROVIDED?_____
12. WAS AN EMERGENCY PHONE CALL MADE TO THE PROJECT SAFETY OFFICER?_____

    IF SO, TIME:_____
13. AMBULANCE SERVICE USED_____
14. HOSPITAL USED_____
15. ATTENDING PHYSICIAN_____
16. COMPANY REPRESENTATIVE CONTACTED_____
17. CONTRACTOR REPRESENTATIVES CONTACTED_____



SOURCE: USGS 7.5 MIN. TOPOGRAPHIC MAP, GRANITE CITY, IL.-MO. QUADRANGLE, 1993.

0' 1000' 2000' 4000'

SCALE IN FEET

ILLINOIS

QUADRANGLE LOCATION

N

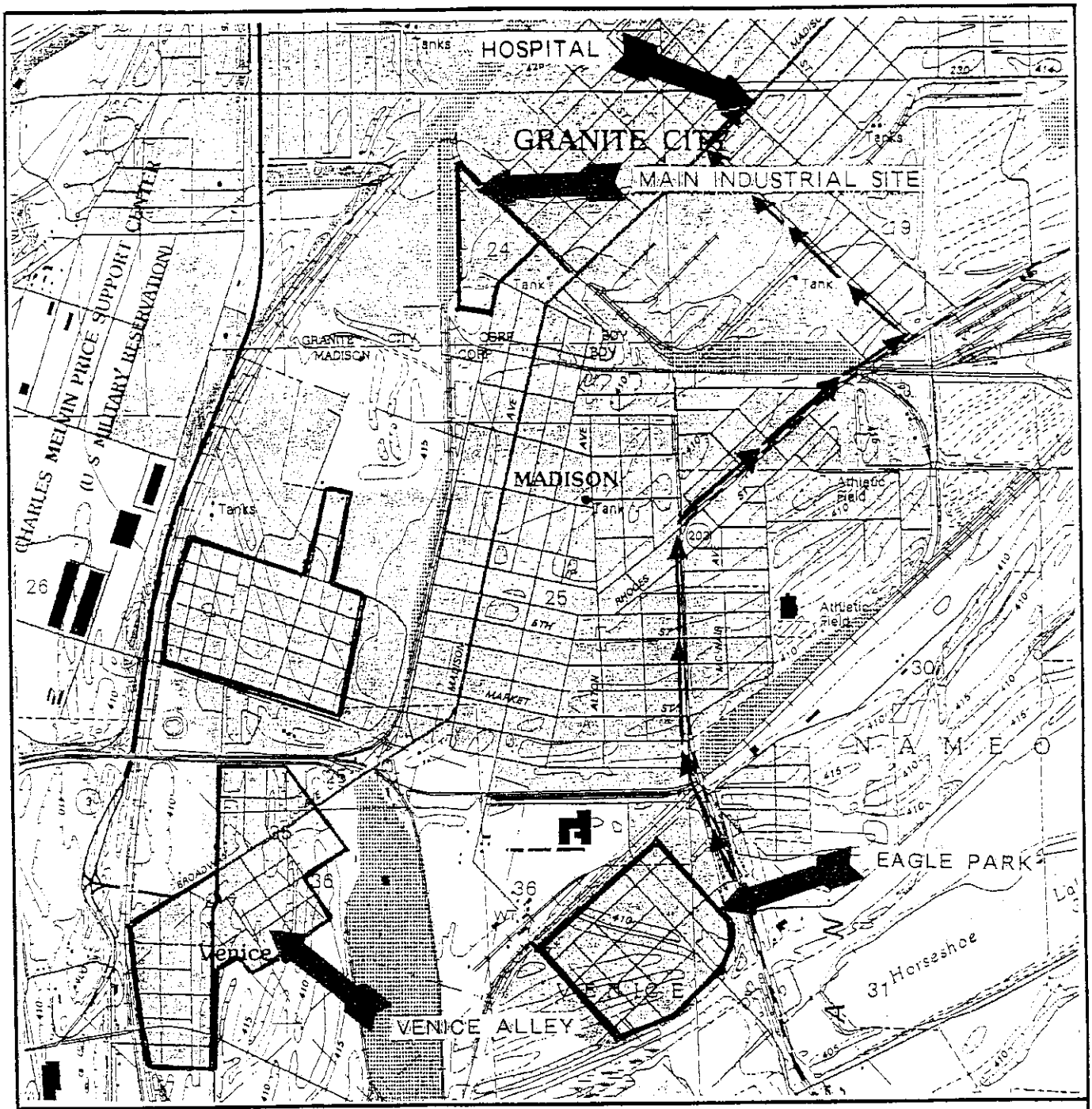
ARCADIS GERAGHTY & MILLER

35 East Wacker Drive
Suite 1000, Chicago, Illinois 60601
Tel: 312/263-6703 Fax: 312/263-7897

EMERGENCY ROUTE TO HOSPITAL
MAIN INDUSTRIAL SITE
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

PROJECT NUMBER
CI01003.001

FIGURE NUMBER
6



SOURCE: USGS 7.5 MIN. TOPOGRAPHIC MAP, GRANITE CITY, IL.-MO. QUADRANGLE, 1993.

0' 1000' 2000' 4000'

SCALE IN FEET

ILLINOIS

QUADRANGLE LOCATION

N

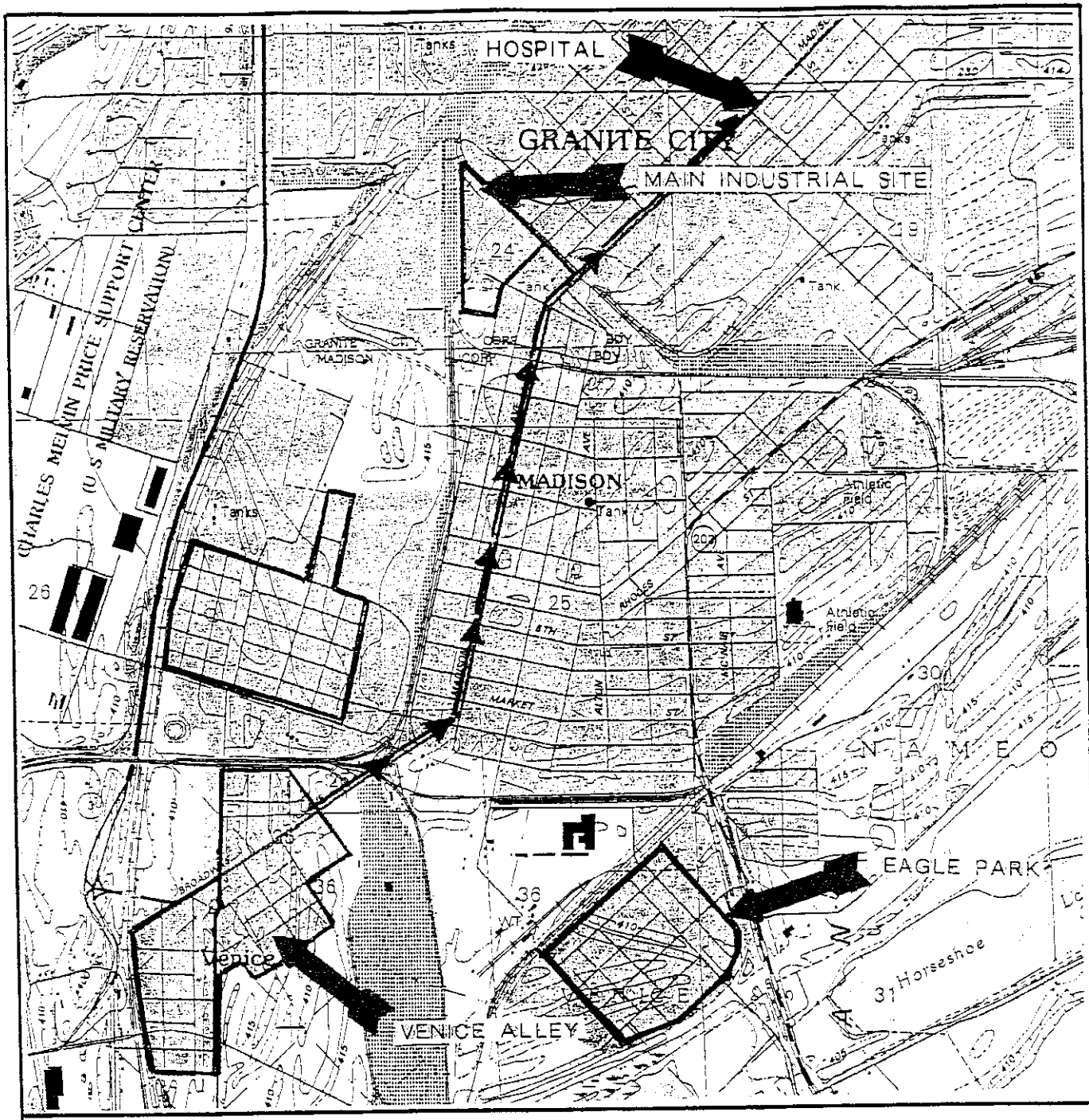
ARCADIS GERAGHTY & MILLER

35 East Wacker Drive
Suite 1000, Chicago, Illinois 60601
Tel: 312/263-6703 Fax: 312/263-7897

EMERGENCY ROUTE TO HOSPITAL
EAGLE PARK
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

PROJECT NUMBER
CI01003.001

FIGURE NUMBER
7



SOURCE: USGS 7.5 MIN. TOPOGRAPHIC MAP, GRANITE CITY, IL.-MO. QUADRANGLE, 1993.

0' 1000' 2000' 4000'

SCALE IN FEET

QUADRANGLE LOCATION

ARCADIS GERAGHTY & MILLER

35 East Wacker Drive
Suite 1900, Chicago, Illinois 60601
Tel: 312/263-6703 Fax: 312/263-7897

EMERGENCY ROUTE TO HOSPITAL
VENICE ALLEY
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

PROJECT NUMBER
CI01003.001

FIGURE NUMBER
8

ATTACHMENTS

ATTACHMENT C-1

Compound Characteristics

TAL Metals

List Includes:	Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc	
Exposure Limits:	0.002 mg/m^3 (TWA) (most limiting Beryllium and Calcium compounds)	
Physical Description:	Powdery or solid	
Personal Protection and Sanitation:	Clothing:	Wear appropriate equipment to prevent repeated or prolonged skin contact
	Goggles:	Wear eye protection to prevent reasonable probability of eye contact
	Wash:	Workers should wash promptly when skin becomes contaminated
Routes of Entry:	Ingestion, skin/eye contact	
Symptoms:	Irritation eyes, respiratory problems, cough, tight chest, chills, muscle aches, nausea, vomiting, diarrhea, carcinogenic	
First Aid:	Eyes:	Immediately wash eyes with large amounts of water
	Skin:	Promptly wash the contaminated skin with soap and water
	Breathing:	Move exposed person to fresh air at once. If breathing has stopped, provide mouth-to-mouth resuscitation

ATTACHMENT C-2

Monitoring, Prevention and Air for Heat Stress

MONITORING, PREVENTION AND AID FOR HEAT STRESS

Heat Stress

Wearing personal protection equipment puts a hazardous waste worker at considerable risk of developing hear stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

Monitoring Heat Stress. Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

Workers wearing semi-permeable or impermeable protective clothing should be monitored when the temperature in the work area is above 70°F (21°C).

To monitor the worker, measure:

- Heart Rate--Count the radial pulse during a 30-second period as early as possible in the rest period.
    - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
    - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature--Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
    - If oral temperature exceeds 99.6°F (37°C) shorten the next work cycle by one-third without changing the rest period.
    - If oral temperature still exceeds 99.6°F (37.6°) at the beginning of the next rest period, shorten the following work cycle by one-third.
    - Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss, if possible. Measure weight on a scale accurate to $\pm$0.25 LB at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration.

Weights should be taken while the employee wears similar clothing or, ideally, is nude. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 1). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

TABLE 1
SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING
FIT AND ACCLIMATIZED WORKERSa

Adjusted Temperature[b]	Normal Work Ensemble[c]	Impermeable Ensemble
90°F (32.2°C) of above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32-2°C)	After each 60 minutes of work	After each 30 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[a]For work levels of 250 kilocalories/hour
[b]Calculate the adjusted air temperature (ta adj) by using this equation:
ta adj °F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant hear. Estimate a percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)
[c]A normal working ensemble consists of cotton coveralls or other cotton clothing with long sleeves and plants.

Prevention of Heat Stress. Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion that person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps:

- Adjust work schedules:
  - Modify work/rest schedules according to monitoring requirements
  - Mandate work slowdowns as needed.
  - Rotate personnel: alternate job functions to minimize overstress to overexertion at one task.

- Add additional personnel to work teams.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.

- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 8 ounces (9.32 kg) pf weight lost. The normal third mechanism is not sensitive enough to ensure the enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage workers to drink more. The following strategies may be useful:

  - Maintain water temperature at 50° to 60°F (10° to 15.6°C).

  - Provide small disposable cups that hold about 4 ounces (0.1 liter).

  - Have workers drinks 16 ounces (0.5 liters) of fluid (preferably water or dilute rinks) before beginning work.

  - Urge workers to drink a cup or two every 15 to 20 minutes or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.

  - Weigh workers before and after work to determine if fluid replacement is adequate.

- Encourage workers to maintain an optimal level of physical fitness:

  - Where indicated, acclimatize workers to site work conditions; temperatures, protective clothing, and workload.

  - Urge workers to maintain normal weight levels.

- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:

  - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.

  - Cooling jackets, vests, or suits.

- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress (see Table 2).

Table 2
SIGNS AND SYMPTOMS OF HEAT STRESS

- Heat rash may result from continuous exposure to heat or humid air

- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - Muscle spasms
  - Pain in the hands, feet, and abdomen

- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - Pale, cool, moist skin
  - Heavy sweating
  - Dizziness
  - Nausea
  - Fainting

- Heat stroke is the most serious form of heat stress. Temperature regulations fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms area:
  - Red, hot, usually dry skin
  - Lack of or reduced perspiration
  - Nausea
  - Dizziness and confusion
  - Strong, rapid pulse
  - Coma

Appendix 2

MONITORING WELL CONSTRUCTION DETAILS

Table 1. Groundwater Monitoring Well Network, Groundwater Monitoring Plan
NL Industries/Taracorp Site, Granite City, Illinois.

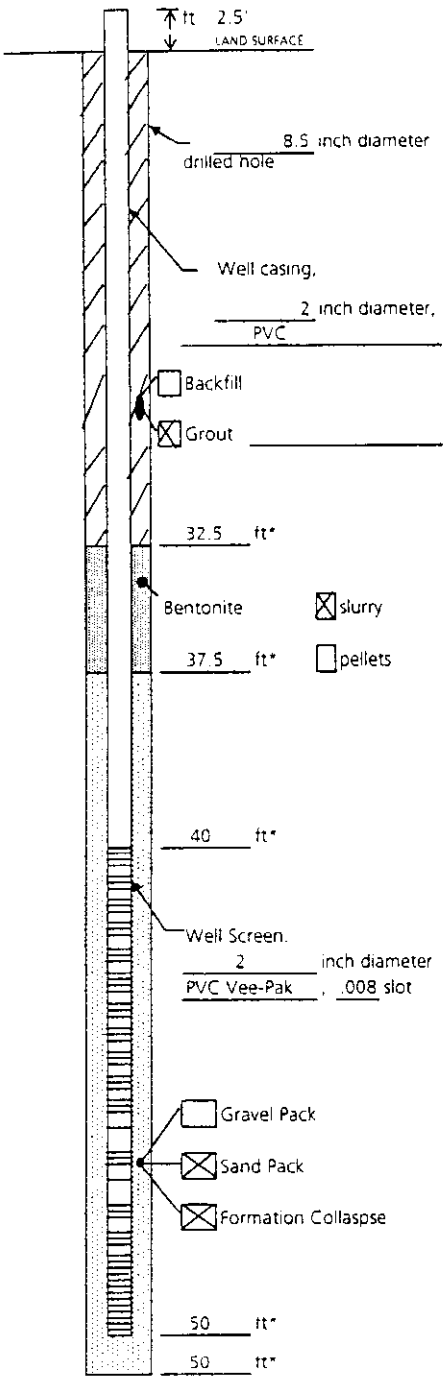
Well Identification	Well Diameter (inches)	Well Depth (ft bls)	Screen Material/ Construction	Screen Length (ft)	Screen Interval (ft bls)	Top of Casing Elevation	Ground Elevation (ft msl)
MW-101	2.0	25.0	Type A	10.0	15.0-25.0	NA	NA
MW-102	2.0	25.0	Type A	10.0	15.0-25.0	NA	NA
GMMW-103R	2.0	23.0	Type B	10.0	13.0-23.0	NA	NA
MW-104	2.0	27.0	Type A	10.0	17.0-27.0	NA	NA
MW-105S	2.0	26.0	Type A	5.0	21.0-26.0	NA	NA
MW-105D	2.0	35.3	Type A	5.0	30.3-35.3	NA	NA
MW-106S	2.0	20.79	Type A	5.0	15.79-20.79	NA	NA
MW-106D	2.0	34.91	Type A	5.0	29.91-34.91	NA	NA
MW-107S	2.0	22.46	Type A	5.0	17.46-22.46	NA	NA
MW-107D	2.0	35.44	Type A	5.0	30.44-35.44	NA	NA
GMMW-108S	2.0	29.0	Type B	10.0	19.0-29.0	NA	NA
MW-108D	2.0	32.26	Type A	5.0	27.26-32.26	NA	NA
GMMW-108X	2.0	50.0	Type B	10.0	40.0-50.0	NA	NA
GMMW-109S	2.0	24.0	Type B	10.0	14.0-24.0	NA	NA
GMMW-109D	2.0	36.5	Type B	10.0	26.5-36.5	NA	NA
GMMW-109X	2.0	50.0	Type B	10.0	40.0-50.0	NA	NA
GMMW-112S	2.0	21.0	Type B	10.0	11.0-21.0	NA	NA
GMMW-112D	2.0	37.5	Type B	10.0	27.5-37.5	NA	NA
GMMW-113S	2.0	22.0	Type B	10.0	12.0-22.0	NA	NA
GMMW-113D	2.0	37.5	Type B	10.0	27.5-37.5	NA	NA
GMMW-115S	2.0	28.0	Type B	10.0	18.0-28.0	NA	NA
GMMW-115D	2.0	41.0	Type B	10.0	31.0-41.0	NA	NA
GMMW-116S	2.0	31.0	Type B	10.0	21.0-31.0	NA	NA
GMMW-116D	2.0	44.0	Type B	10.0	34.0-44.0	NA	NA
GMMW-117	2.0	24.0	Type B	10.0	14.0-24.0	NA	NA
GMMW-118	2.0	34.0	Type B	10.0	24.0-34.0	NA	NA
GMMW-119	2.0	22.0	Type B	10.0	12.0-22.0	NA	NA
GMMW-120	2.0	21.0	Type B	10.0	11.0-21.0	NA	NA
GMMW-121	2.0	20.0	Type B	10.0	10.0-20.0	NA	NA
GMMW-122	2.0	21.0	Type B	10.0	11.0-21.0	NA	NA
GMMW-123	2.0	22.0	Type B	10.0	12.0-22.0	NA	NA
GMMW-124S	2.0	27.0	Type B	10.0	17.0-27.0	NA	NA
GMMW-124D	2.0	40.0	Type B	10.0	30.0-40.0	NA	NA
GMMW-125	2.0	29.0	Type B	10.0	19.0-29.0	NA	NA
GMMW-126	2.0	26.0	Type B	10.0	16.0-26.0	NA	NA

Notes:
All screen material is Polyvinyl chloride (PVC).
Type A screen material is Schedule 40 PVC with 0.010 inch slot size.
Type B screen material is Vee-Pak (pre-sand packed) Schedule 40 PVC with 0.008 inch slot size.
ft feet
bls below land surface
msl mean sea level
NA Not Available

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-108X

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/7/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/16/00, Surge block and Grundfos pump. 200 gallons removed.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 200 gallons

Static Depth to Water 24.32 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

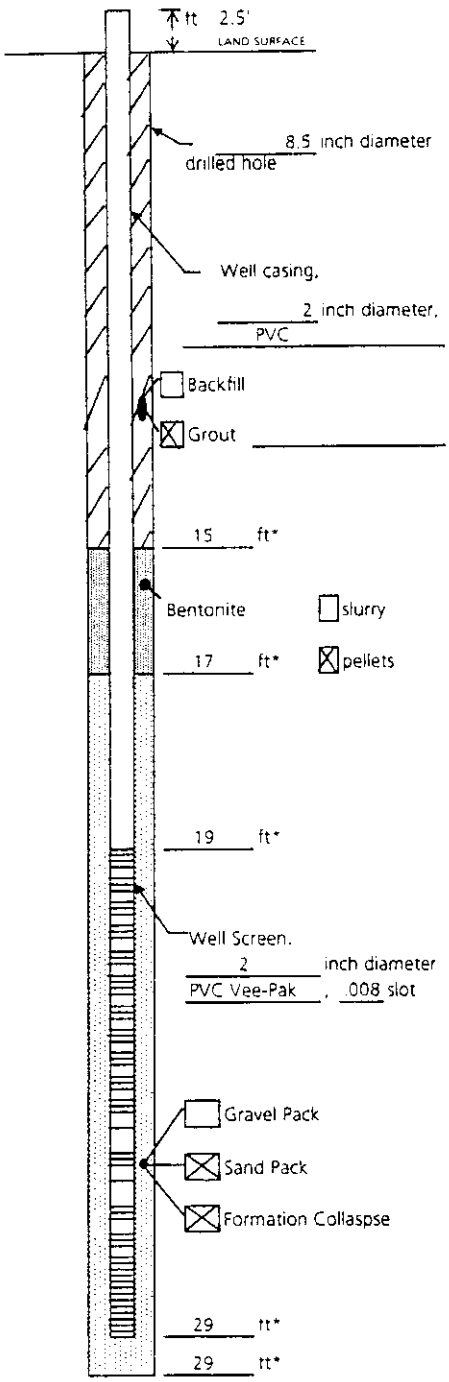
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # C1001003.0003 Well GMMW-108S

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/7/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/16/00, Surge block and purged with bailer.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 10 gallons

Static Depth to Water 23.75 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

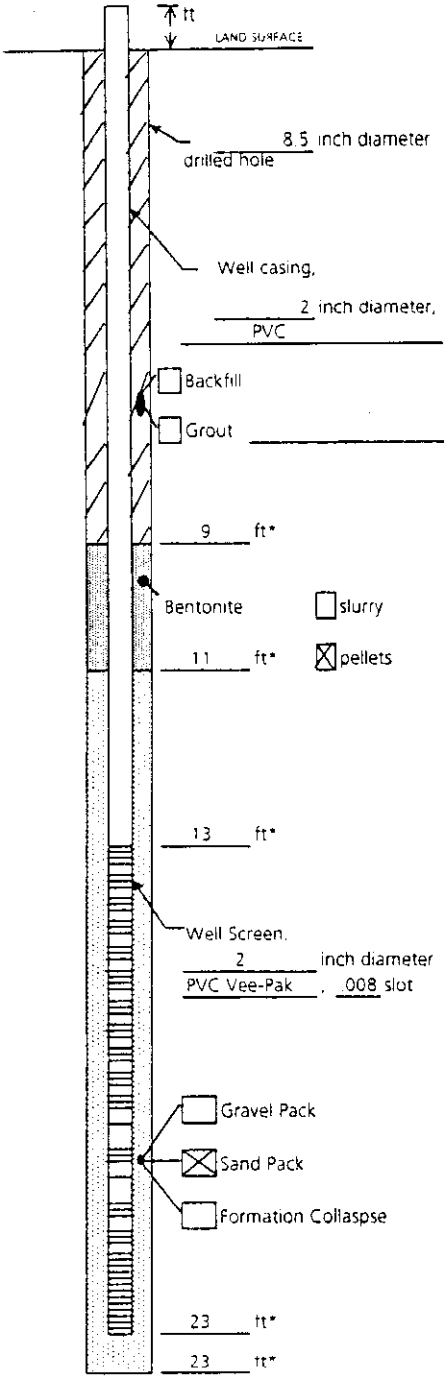
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-103R

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/3/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/8/00, Surge block, 75 gallons, purged with submersible pump.

Fluid Loss During Drilling ____ gallons

Water Removed During Development 75 gallons

Static Depth to Water 18.7 feet below M.P.

Pumping Depth to Water ____ feet below M.P.

Pumping Duration ____ hours

Yield ____ gpm Date ____

Specific Capacity ____ gpm/ft

Well Purpose Monitoring

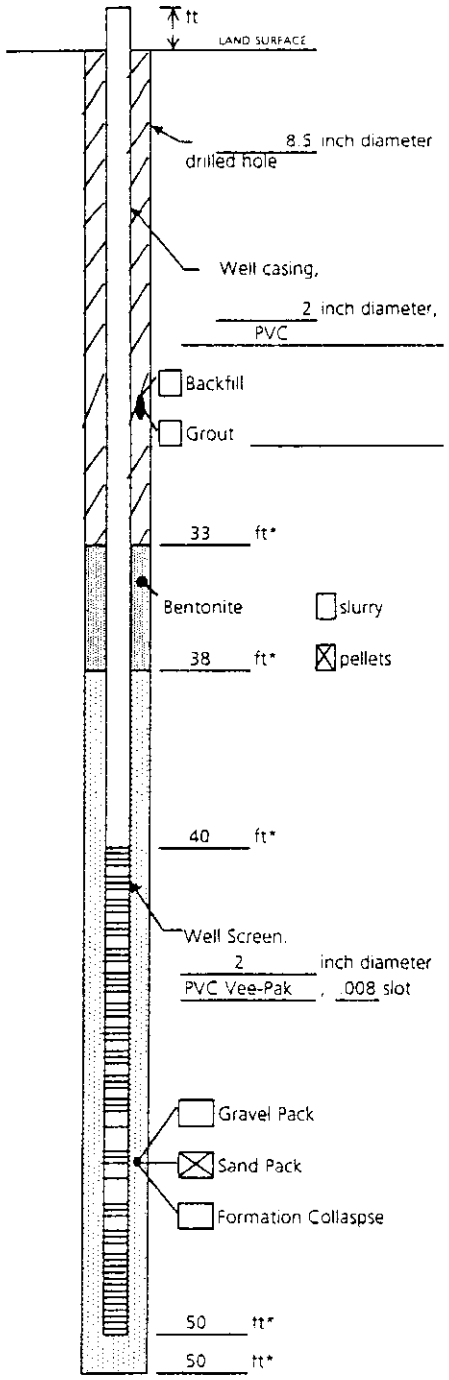
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-109X

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/4/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/16/00, Surge block, bailer and submersible pump

Fluid Loss During Drilling ____ gallons

Water Removed During Development 350 gallons

Static Depth to Water 17.5 feet below M.P.

Pumping Depth to Water ____ feet below M.P.

Pumping Duration ____ hours

Yield ____ gpm Date ____

Specific Capacity ____ gpm/ft

Well Purpose Monitoring

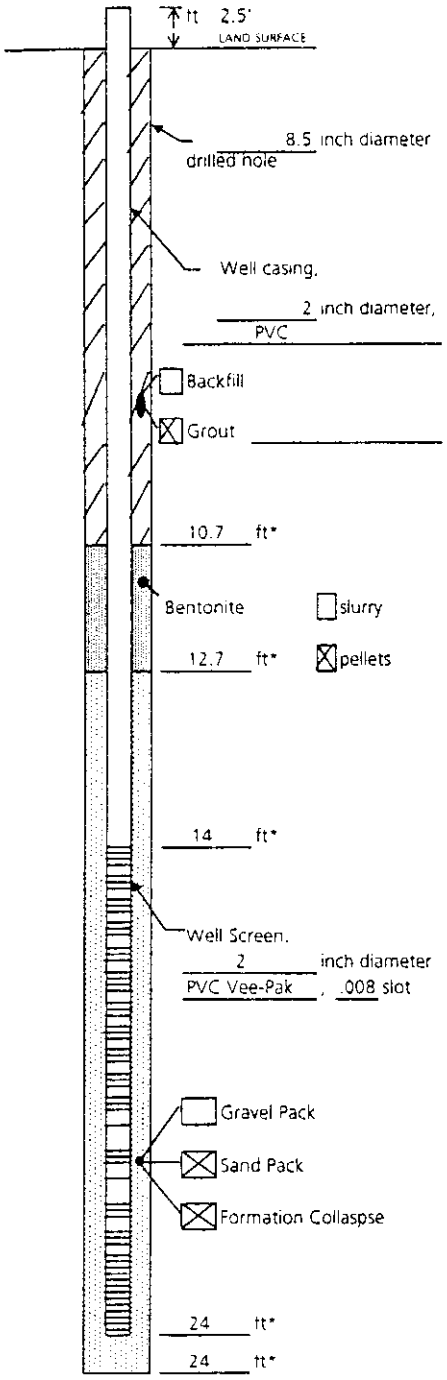
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-109S

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/3/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/8/00, Surge with bailer and pump with submersible pump. Removed 65 gallons.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 65 gallons

Static Depth to Water 20.13 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

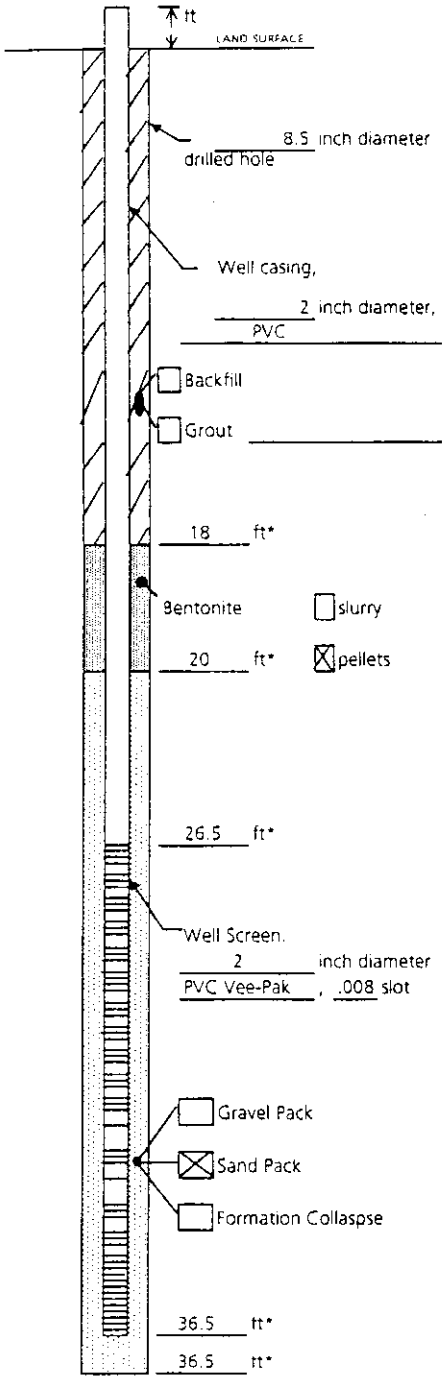
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-109D

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/4/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/8/00, Surge with bailer and purge with submersible pump. Removed 170 gallons.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 170 gallons

Static Depth to Water 17.5 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

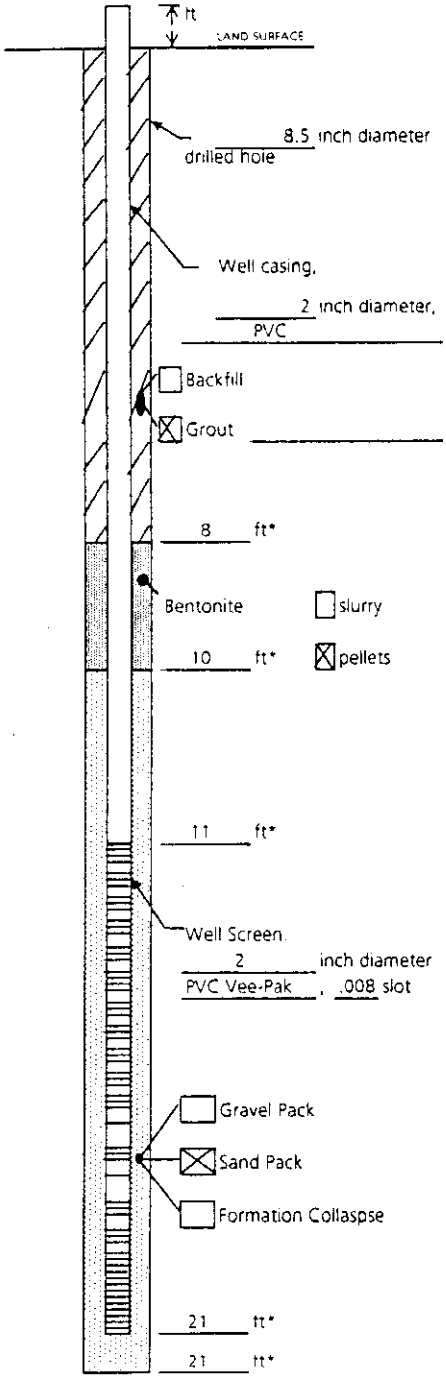
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-112S

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/6/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

Surge with bailer and purged 25 gallons.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 25 gallons

Static Depth to Water 18.34 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

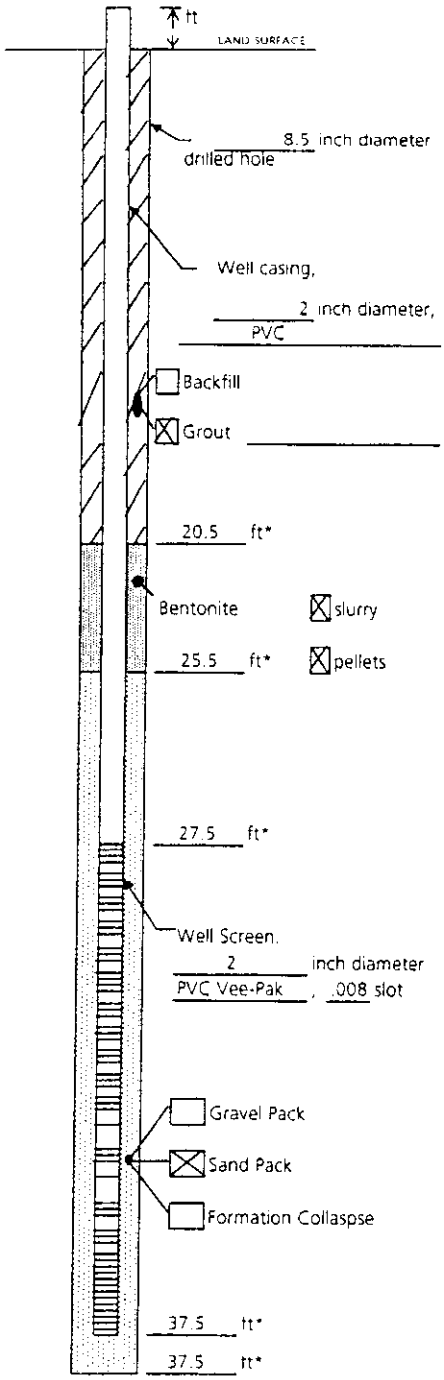
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-112D

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/6/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/16/00, Surge with surge block and purge with submersible pump.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 104 gallons

Static Depth to Water 15.52 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

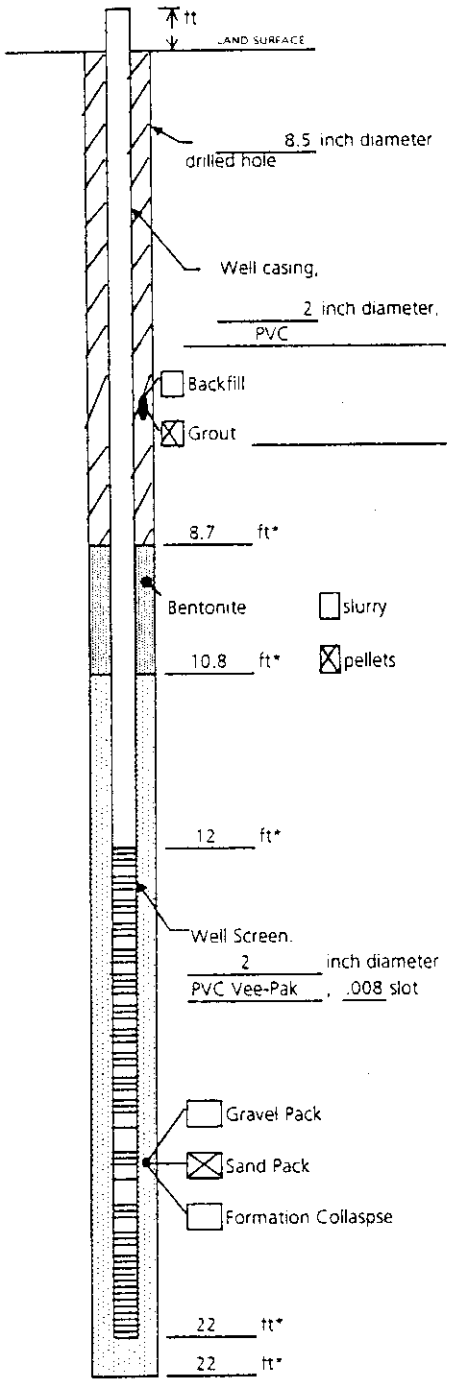
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-113S

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/15/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

3/18/00, Surge with bailer and purge with submersible pump.

Fluid Loss During Drilling _____ gallons

Water Removed During Development 40 gallons

Static Depth to Water 15.60 feet below M.P.

Pumping Depth to Water _____ feet below M.P.

Pumping Duration _____ hours

Yield _____ gpm Date _____

Specific Capacity _____ gpm/ft

Well Purpose Monitoring

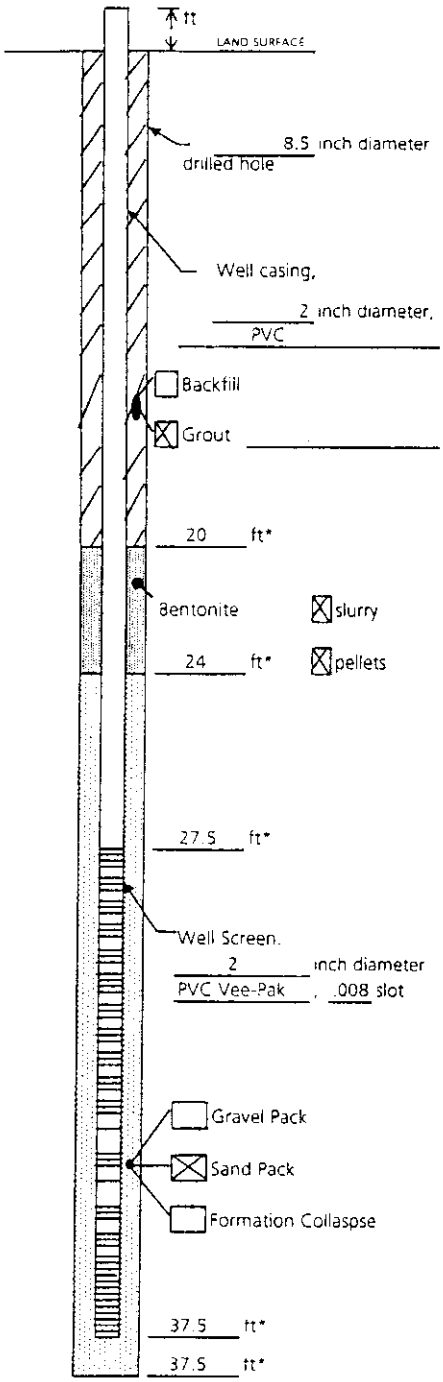
Remarks

Prepared by Adam Tokarski

ARCADIS GERAGHTY & MILLER

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NL Industries/Taracorp Superfund Site

Project # CI001003.0003 Well GMMW-113D

Town/City Granite City

County Madison State Illinois

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 3/15/00

Drilling Method Hollow Stem Augres 4.25" diameter

Drilling Contractor Phillip Services Corporation

Drilling Fluid None

Development Technique(s) and Date(s)

Surge with surge block and purged with submersible pump

Fluid Loss During Drilling ____ gallons

Water Removed During Development 100 gallons

Static Depth to Water 15 feet below M.P.

Pumping Depth to Water ____ feet below M.P.

Pumping Duration ____ hours

Yield ____ gpm Date ____

Specific Capacity ____ gpm/ft

Well Purpose Monitoring

Remarks

Prepared by Adam Tokarski

Appendix 3

EXCERPTS FROM GROUNDWATER MONITORING PLAN

**(Prepared by ARCADIS Geraghty & Miller, Inc.
as part of the September 2001 Groundwater Monitoring Plan)**

3.0 Groundwater Sampling

During the implementation of this plan, groundwater samples will be collected from all of the wells in the monitoring well network (refer to Table 1) for laboratory analysis of lead, cadmium, and zinc and field measurements of indicator parameters (i.e., pH, temperature, specific conductivity, turbidity, and oxidation/reduction potential). Groundwater sampling and analysis activities conducted under this Plan will be performed in accordance with the approved Quality Assurance Project Plan (QAPP) for the Site (ARCADIS Geraghty & Miller 1999).

Groundwater samples will be collected from the monitoring well network on an annual basis for three (3) years in 2001 (Spring), 2002 (Summer), and 2003 (Winter). After completion of three years of groundwater monitoring, ARCADIS Geraghty & Miller will assess the appropriate frequency for further monitoring. ARCADIS Geraghty & Miller's assessment will also evaluate whether certain monitoring wells may be closed and eliminated from further monitoring. ARCADIS Geraghty & Miller's assessment and recommendations will be provided to U.S. EPA for consideration.

The groundwater samples will be submitted to the approved project laboratory for analysis of lead, cadmium, and zinc (Table 3). The groundwater samples will be collected using low-flow sampling methods and will be analyzed by the project laboratory for total lead, cadmium, and zinc (i.e., unfiltered samples). Groundwater samples will be collected using low-flow sampling methods to minimize the turbidity of the groundwater samples.

The field procedures that will be followed during the groundwater sampling activities are discussed in the following sections.

3.1 Preparation of Well for Sampling

3.1.1 Sounding the Well

Upon arrival at the well location, sampling personnel will check the well for damage, record the well designation, wipe the top of the well clean, and then remove the cap and wipe the top of the well casing with a clean cloth. The condition of the well will be recorded in the field notebook by the sampling team.

The total depth of the well to be sampled will be measured (sounded) prior to sampling. This will enable the sampling team to calculate the volume of standing

water in the well and to determine if formation solids have passed through the screen and accumulated in the well. The well depth will be measured to an accuracy of ± 0.1 feet.

The height of the measuring point above ground surface (the stick-up) will be measured as an indicator of whether the well has been disturbed since installation. The stick-up will be measured to an accuracy of ± 0.1 feet.

3.1.2 Measuring the Water Level

Prior to sampling, the static water level in the well will be measured and the volume of standing water in the well will be calculated. Each measurement will be made to an accuracy of ± 0.01 feet below the measuring point. The order of water level measurements will be from wells with lower detected concentrations, to those with known higher constituent concentrations.

3.1.3 Purging the Well

Standing water will be removed from any flush-mount well casings prior to sampling. The monitoring well will be purged using a low-flow submersible pump. The pump will be decontaminated using a pressurized steam cleaner between well locations. New disposable tubing will be used with the pump at each well location.

At a minimum, a purge volume equal to three times the calculated volume of standing water in the well will be removed to ensure that the sample collected will be representative of the groundwater within the zone screened. During purging, the field parameters pH, temperature, specific conductance, and turbidity will be measured after each well volume has been removed from the well using an in-line, flow-through cell. Additional purging may be required to ensure that the field measurement parameters have stabilized before the well is sampled. The field parameters will be considered stable when two successive measurements vary by less than 0.5 degrees Celsius for temperature, 10% for conductance and turbidity, and 0.5 pH units. The unit of measurement for turbidity will be Nephelemetric Turbidity Units (NTUs).

The volume of standing water in each well will be calculated using the following equation:

$$V = \pi (r^2) (h) (7.48)$$

where:

V = well volume (gal)
r = well radius (ft)
h = column of water in the well (total depth - depth to water) (ft)

Purge water will be containerized from wells at the Main Industrial Site that are located in the vicinity of the former source area (i.e., Monitoring Wells MW-101. MW-104, and GMMW-108S, D, X), or from wells that are located in areas of the Main Industrial Site that contained waste materials that were consolidated in the closed Taracorp pile (Monitoring Wells GMMW-112S, D). The purged water from these wells will be containerized and conveyed inside the fenced area at the former BV&G Trucking for temporary storage prior to characterization sampling and discharge to the City of Granite City sanitary sewer system. A grab sample of the purge water will be collected and analyzed for cadmium, lead, and zinc, cyanide, total phenols and pH.

The results of the laboratory analysis will be submitted to the City of Granite City Regional Wastewater Treatment Plant (WWTP) with a request for permission to discharge the purge water to the sanitary sewer system. The proposed sanitary sewer discharge point is the sewer manhole located at the 15th and State Streets. A copy of the authorization issued by the City of Granite City WWTP to discharge purge water generated during the pre-design groundwater investigation to the sanitary sewer system is provided in Appendix C.

The purge water from all other wells, including the monitoring wells in the two Remote Fill Areas (Venice Township and Eagle Park Acres), and the off-site monitoring wells at the Main Industrial Site will be allowed to infiltrate onto the ground at each location.

3.2 Field Analyses

During well purging and prior to groundwater sampling at each well, measurements for dissolved oxygen, oxidation/reduction potential, conductivity, pH, temperature, and turbidity will be made in the field using a YSI 6000 series meter, or equivalent.

3.3 Groundwater Sampling

The following groundwater sampling procedures will be followed under this Plan for low-flow sample collection using a submersible pump:

1. Measure the depth to water with an electronic water-level device from the top of casing and record the measurement in the logbook. Do not measure the depth to the bottom of the well at this time (in order to avoid disturbing any accumulated sediment). Obtain depth to bottom information from measurements collected prior to sampling.

2. Measure the depth to water in the well again. If the measurement has changed more than 1/10th of a foot, check and record the measurement again.

3. Attach and secure the discharge tubing to the low-flow submersible pump. Lower the pump slowly lowered into the well to prevent disturbing the water column. If the pump cannot be installed in the well due to an obstruction or damage to the well, a bailer may be used to sample the well.

4. The pump should be set at approximately the middle of the screen. Avoid placing the pump intake less than two feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well. Cover the discharge line between the flow-through cell and the well cap with foam insulation to minimize temperature change. Start purging the well. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface. Record the start time on the water sampling log.

5. The water level in the well should be monitored during purging, and ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well. (The water level should stabilize for the specific purge rate). There should be at least one foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water. Purge rates should be decreased to the minimum capabilities of the pump to avoid affecting well drawdown. The well should not be purged dry. If the recharge rate of the well is so low that the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of water for the sample with the pump.

6. During well purging, use the flow-through cell to monitor the field parameters every 3 to 5 minutes. If the field parameters fail to stabilize within two hours and three well volumes have not been purged, move the meter to the next well to be sampled and continue to purge the first well. Field parameters will be monitored every one to two hours until they stabilize or three well volumes are removed.

7. Once the field parameters have stabilized, collect the samples directly from the end of the discharge tube. All sample bottles should be filled by allowing the water from the discharge tube to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled. Record sample completion time on the sampling log.

8. Field equipment will be calibrated and operated in accordance with manufacturer's instructions. Documentation of calibrations will be recorded in the field log book. Copies of all instruction manuals for calibration and operation will be available for review by the sampling personnel at the Site.

3.4 Equipment Decontamination

Before the start of groundwater sampling activities, between each well sampled, and prior to leaving the Site, the groundwater sampling equipment will be decontaminated. The pump used to purge and sample the monitoring wells will be thoroughly cleaned between each well location.

The decontamination procedures for the submersible pump are presented below:

1. Personnel will wear disposable gloves during the decontamination procedures and will change gloves as necessary.

2. The submersible pump used to purge the well will be removed and placed along with the electrical cord, into a clean bucket. The equipment will be rinsed with distilled water.

3. The interior and exterior of the submersible pump will be rinsed with a laboratory-grade detergent solution. A scrub brush will be used on the pump and cord to remove surficial contaminants.

4. The pump and the electrical cord will be placed in a clean pail and the interior and exterior will be thoroughly rinsed with distilled water.

5. The distilled water used to rinse the pump and electrical cord will be changed for each decontamination procedure.

6. The clean pump and cord will be placed in a clean plastic bag.

If a peristaltic pump is used, no decontamination of the pump is necessary due to the non-contact nature of the groundwater sample. However, new dedicated tubing is needed for the pump between each monitoring well sample.

3.5 Quality Control Samples

The quality assurance/quality control program is defined to meet the quality assurance objectives described in the project QAPP. Site-specific control samples involve the collection of field replicates and equipment blanks. A summary of the sampling and analysis program to be performed during the implementation of this plan is presented in Table 4.

3.6 Sample Custody And Shipment

Sample custody procedures are defined in the project QAPP. They are designed to comply with U.S. EPA requirements for sample control. All samples will remain in the custody of sampling personnel from the time of collection until transfer to a representative of the courier service for delivery to the laboratory. Standard chain-of-custody procedures will be followed to maintain and document sample possession and transfer.

3.6.1 Field Custody

Detailed field-specific procedures, including field sample handling procedures and field log book documentation requirements, are described in the project QAPP.

3.6.2 Transfer of Custody for Shipment

Procedures for transferring custody of samples are detailed in the project QAPP.

3.6.3 Sample Shipment Procedures

As indicated in the project QAPP, the following procedures will be followed when shipping samples for laboratory analysis:

1. Samples requiring refrigeration will be promptly chilled to a temperature of between 1 and 4°C and packaged in an insulated shipping container or cooler on ice for transport to the project laboratory.

2. Only shipping containers which meet all applicable state and federal Department of Transportation standards for safe shipment will be used.

3. The Chain-of-Custody Record and Laboratory Task Order will be placed inside the shipping container in a sealed plastic envelope.

4. The shipping containers will be sealed with a Chain-of Custody seal that will allow the laboratory receiver to quickly identify any tampering which may occur during transport to the laboratory.

5. Shipment will be by courier service and receipt of shipment will be retained with Chain-of-Custody Record.

3.6.4 Laboratory Custody

Upon receipt of the samples at the laboratory, the laboratory custody procedures described in the project QAPP will be followed.

3.7 Data Validation

The overall quality assurance objective is to ensure that monitoring data of known and acceptable quality are obtained. To achieve this objective, sample collection and chain-of-custody procedures will be implemented to ensure that representative samples are collected for analysis. The analytical data will be validated together with the laboratory in accordance with the QAPP to ensure it meets precision, sensitivity, accuracy, completeness, representativeness, and comparability requirements. The laboratory deliverables provided for groundwater samples collected under this Plan will correspond to ARCADIS Geraghty & Miller's Level II deliverables for inorganic analyses (Appendix D).

3.8 Reporting

The results of the monitoring and sampling performed during the implementation of this plan will be documented in an Annual Report, which will be submitted to the U.S. EPA. The report will present the following information:

1. Description of field activities:
   - status and integrity of the monitoring well network; and
   - discussion of any changes in sampling protocol.
2. Summary of groundwater quality data:
   - validated analytical data summary tables;
   - discussion of data validation results; and
   - evaluation of groundwater quality.
3. Summary of water level data:
   - water level data summary tables; and
   - potentiometric maps.

Groundwater level data will be tabulated and used to generate groundwater potentiometric contour maps of the Site. Tables will summarize the validated analytical results, including the constituents analyzed, concentrations detected, qualifiers added during validation, detection limits, sample location, and date of sampling. The annual report will also include a brief narrative description of the conclusions of the groundwater sampling event and any recommendations that may be appropriate for future activities.

3.9 Health And Safety

The groundwater monitoring plan will be conducted in accordance with the procedures contained in the site-specific Health and Safety Plan for the NL Industries/ Taracorp Superfund Site (ARCADIS Geraghty & Miller 1999).

Appendix 4

QUALITY ASSURANCE PROJECT PLAN

(Prepared by ARCADIS Geraghty & Miller, Inc. as part of the August 2000 Final Pre-Design Investigation Work Plan for Groundwater)

ARCADIS GERAGHTY & MILLER

Pre-Design Investigation Work Plan For Groundwater NL Industries/Taracorp Superfund Site Granite City, Illinois

APPENDIX B

Quality Assurance Project Plan

ARCADIS Geraghty & Miller, Inc.
35 East Wacker Drive, Suite #1000
Chicago, Illinois 60601

REPORT

September 1999

PRE-DESIGN INVESTIGATION WORK PLAN FOR GROUNDWATER
NL INDUSTRIES/TARACORP SUPERFUND SITE
GRANTIE CITY, ILLINOIS

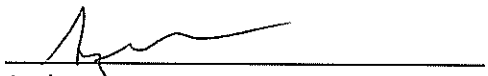
APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

	APPROVAL	DATE
Consultant Project Manager	ARCADIS Geraghty & Miller, Inc.	
Consultant Project Officer	ARCADIS Geraghty & Miller, Inc	

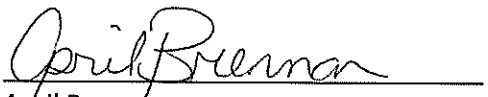
Note: The Quality Assurance Project Plan (QAPP) was implemented by ARCADIS Geraghty & Miller, Inc. (and subsequently ARCADIS) during previous groundwater activities performed at the NL Industries/Taracorp Superfund Site in Granite City, Illinois, including those activities performed by ARCADIS during the most recent groundwater monitoring event performed in 2009.

Environmental Works, Inc. (EWI) will implement the QAPP, subject to the modifications addressed in EWI's January 14, 2014 QAPP Amendment, during the five-year review groundwater monitoring event and related activities to be performed in 2014.



Anthony Moore
Environmental Works, Inc.
Project Manager

1/16/14
Date



April Brennan
Environmental Works, Inc.
Quality Assurance Manager

1-16-2014
Date

TABLES

Section Title Page

ATTACHMENTS

1.0 Introduction

The United States Environmental Protection Agency (USEPA) requires that all environmental monitoring and measurement efforts mandated or supported by USEPA participate in a centrally managed quality assurance (QA) program. Any party under this program has the responsibility to implement minimum procedures to assure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure the responsibility is met uniformly, a written QA project plan (QAPP) is required.

This QAPP presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with Pre-Design Investigation activities to be completed by ARCADIS Geraghty & Miller on behalf of the NL Industries/Taracorp Site Group at the NL Industries/Taracorp Site (the Site). This QAPP also describes the specific protocols which will be followed for sample handling and storage, chain of custody, and laboratory analysis.

All QA/QC procedures will be followed in accordance with applicable professional technical standards, USEPA requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP was prepared by ARCADIS Geraghty & Miller, Inc. (ARCADIS Geraghty & Miller) in accordance with all USEPA QAPP guidance documents, including "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS-005/80) (1983), and the "Region V Model Superfund Quality Assurance Project Plan" (QAPP) (1991a).

2.0 Site and Project Description

2.1 Project Description

The reader is referred to Section 2.0 (Background) of the Pre-Design Investigation Work Plan for a description of the Site, and a summary of the pertinent site background and operating history. This plan specifically addresses the quality assurance procedures that will be followed during performance of the Pre-Design Investigation at the Site.

2.2 Pre-Design Investigation Objectives

The first step in the remedial design process is to thoroughly understand the groundwater chemistry at the Site and its interaction with the solid phases of the aquifer, the groundwater flow field (especially at the Main Industrial Site), and the expectations for solute transport. The primary objectives of the Pre-Design Investigation include the following:

1. Determine the extent to which constituents of concern in groundwater have migrated vertically or horizontally at the Site;

2. Determine the degree to which constituents of concern have been immobilized by adsorption onto particles in the aquifer; and

3. Assess the existing geochemistry of the Site soil and groundwater and the tendency for constituents of concern to react, dissolve, or otherwise naturally attenuate.

2.3 Pre-Design Investigation Monitoring Wells

The field procedures to be used for installation of new and replacement monitoring wells, groundwater sampling and analysis, slug testing, and cation exchange capacity soil sampling are described in the sections below.

2.3.1 Existing Monitoring Well Evaluation

The existing wells at the Main Industrial Site have not been sampled in nearly five years. The first Pre-Design Investigation activity to be performed by ARCADIS Geraghty & Miller for the Group will be to redevelop the existing wells to ensure that they are redeveloped to see if they are still suitable as monitoring points capable of

producing low turbidity samples. In order to accurately determine the concentration of dissolved metals in groundwater, it is crucial to obtain sediment free water from the wells. If redevelopment of any given well is not successful, the well will be replaced. Additionally, if any of the wells have been visibly damaged or if sampling a well is otherwise no longer feasible, it will be replaced.

Redevelopment of the existing wells will be performed by overpumping followed by surging, as necessary. A surge block (or air lift) will be lowered into each well, and will then be raised and lowered in a fashion that will surge the water through the well screen and remove fine material that may have entered the well or which may be partially clogging the well screen.

2.3.2 New Monitoring Well Installation

The replacement and new wells associated with the pre-design investigation will be installed using hollow stem auger drilling techniques and standard split-spoon samplers. Prior to initiating drilling and between each borehole, the auger flights, drill rig, and all downhole equipment will be cleaned using a pressurized steam cleaner.

2.3.3 Well Construction

The proposed construction for the new monitoring wells is described in the following paragraphs.

A total of 23 monitoring wells are expected to be installed as part of the proposed Pre-Design Investigation. This total includes the following:

- An estimated five (5) replacement wells at the Main Industrial Site;
- Five (5) new well clusters (shallow and intermediate depths) at or near the Main Industrial Site;
- Two (2) new deeper wells at existing clusters MW108 and MW109; and
- Three (3) new wells at each of the two remote fill areas referred to as Venice Alley and Eagle Park.

The well installations will be performed using a truck-mounted drill rig and hollow-stem augers. The wells will be installed to varying depths, the details of which are summarized in Table 1 of the FSP. The monitoring wells will be installed by Rock &

Soil Drilling Corporation of St. Charles, Illinois, or another qualified drilling subcontractor, under the supervision of an ARCADIS Geraghty & Miller geologist. The drilling task will consist of the following activities:

1. Continuous soil samples will be collected from the unsaturated zone in each of the soil borings. The soil samples will be screened in the field by an ARCADIS Geraghty & Miller geologist for visual signs of contamination.

2. During drilling operations, the lithology of the soil samples will be classified by the ARCADIS Geraghty & Miller geologist in accordance with the Unified Soil Classification System (ASTM D2487).

The well construction details are summarized in the FSP. Significant aspects of the well installation operations are repeated here for convenience:

- All downhole equipment will be steam cleaned between each location and sampling equipment will be decontaminated with a non-sudsing detergent and rinsed with distilled water between each sample interval.

- Each well will be developed with a bailer, surge block (or air lift), and electrical pump to remove a minimum of ten well volumes or until water clarity is achieved.

- All soil cuttings, development fluid, and decontamination water will be drummed and staged at the Main Industrial Site for subsequent characterization and disposal, as appropriate.

2.3.4 Groundwater Sampling

As part of the Pre-Design Investigation, two rounds of groundwater samples for laboratory analysis and field measurements of indicator parameters (i.e., pH, temperature, specific conductivity, oxidation/reduction potential and turbidity) will be collected from all monitoring wells. The procedures that will be followed during the groundwater sampling activities can be found in the FSP.

2.3.5 Hydraulic Conductivity Testing

A series of five in situ hydraulic conductivity tests will be conducted at the Main Industrial Site to evaluate the hydraulic characteristics of the shallow aquifer. These data will be used to supplement existing data on the flow characteristics of the surficial

aquifer. The wells that will be used in the testing and the procedures for testing are defined in the FSP.

2.3.6 Cation Exchange Capacity Sampling

As part of the monitoring well installation, soil samples will be collected at varying depths for representation of the saturated soils. These samples will be taken in accordance with the procedures defined in the FSP. Up to twenty (20) soil samples will be selected for laboratory testing of cation exchange capacity. This analysis will be performed in the ARCADIS Geraghty & Miller treatability laboratory in Raleigh, North Carolina, or another commercial laboratory and will be conducted in accordance with U.S. EPA SW-846 Method 9081. The analytical method is included in Attachment B-1 as excerpted from the third edition of SW-846.

2.4 Sample Network Design and Rationale

The sample network design and rationale for sample locations is described in detail in the Field Sampling Plan (FSP), which is Appendix A of the Pre-Design Investigation Work Plan.

2.5 Parameters to be Tested and Frequency

Two rounds of groundwater samples will be collected from the existing and the newly installed monitoring wells at the Main Industrial Site during the Pre-Design Investigation. During the initial round, groundwater samples will be collected from each of the monitoring wells at the Main Industrial Site and submitted for analysis of the Target Analyte List (TAL) of metals for both total metals (i.e., unfiltered samples) and dissolved metals (i.e., filtered samples). The unfiltered set of groundwater samples from the monitoring wells will also be analyzed in the laboratory for selected geochemical parameters (total dissolved solids, alkalinity, sodium, potassium, calcium, magnesium, sulfate and nitrate species). In addition, field measurements of the pH, turbidity, temperature, conductivity, and oxidation-reduction potential (ORP) of the shallow groundwater at each well location will be made at the time of sample collection.

During the initial sampling event at the Main Industrial Site, groundwater samples will also be collected from each of the monitoring wells using low flow techniques (developed several years ago to minimize the turbidity in groundwater samples). The groundwater samples collected using low flow techniques will be analyzed in the laboratory for TAL lead and cadmium only, and two additional metals (based on the results of the samples analyzed for total metals concentrations). The groundwater

samples collected using low-flow sampling methods will be held in the project laboratory until the laboratory analyses of the unfiltered groundwater samples have been completed. (The holding time for the Method 6010 Target Analyte List metals analysis is six months). The two most frequently detected TAL analytes (other than lead and cadmium) with the highest quantified concentrations will be identified from the analytical results for the unfiltered groundwater samples collected during the initial round. ARCADIS Geraghty & Miller will then instruct the project laboratory to analyze for these two analytes (in addition to lead and cadmium) in the held groundwater samples collected using low-flow sampling methods.

A second round of groundwater sampling will be conducted at the Main Industrial Site following receipt of the results from the first round of sampling. Groundwater samples collected during the second round of sampling will be analyzed for the reduced set of TAL metals for both dissolved (filtered) and total (unfiltered) metals. The groundwater samples collected for total metals analyses will be collected using low-flow sampling methods. Field measurements of pH, conductivity, ORP, temperature and turbidity will also be collected during the second sampling event.

During the initial groundwater sampling event at the Main Industrial Site, groundwater samples will also be collected from the newly installed wells in the Remote Fill Areas (Venice Township and Eagle Park Acres). The groundwater samples collected from the Remote Fill Areas will be submitted for laboratory analysis of TAL lead for both total lead (i.e., unfiltered samples) and dissolved lead (i.e., filtered samples). The groundwater samples collected for total lead analysis will be collected using low-flow sampling methods. The results of the lead analysis will be used as an indicator of potential impacts to groundwater in the Remote Fill Areas as a result historic filling activities.

A summary of the Pre-Design Investigation sampling program including sample matrices, analytical parameters, and frequencies of sample collection is presented in Table 1. The sample container types, required preservation and holding times for the analytical methods specified for the Pre-Design Investigation at the NL Industries/Taracorp Site are summarized in Table 2.

2.6 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during the project and are based on the end uses of the data to be collected. As such, different data uses

may require different levels of data quality. To assist in the interpretation of data, the Superfund program has developed the following two descriptive data categories:

- Screening data with definitive confirmation; and,
- Definitive data.

These two data categories are associated with specific quality assurance and quality control elements, and may be generated using a wide range of analytical methods.

The analytical data to be collected during the Pre-Design Investigation is categorized as definitive data. Definitive data are generated using rigorous analytical methods, and are analyte-specific, with confirmation of analyte identity and concentration. Groundwater samples collected during the Pre-Design Investigation will be analyzed for the analytes identified in Table 1 using the methods identified on Table 3.

2.7 Project Schedule

A discussion regarding the project schedule can be found in Section 5.0 of the Pre-Design Investigation Work Plan.

3.0 Project Organization and Responsibilities

ARCADIS Geraghty & Miller will be responsible for the overall management of Pre-Design Investigation activities. Responsibilities of key project personnel are described in Section 4.0 of the Pre-Design Investigation Work Plan. ARCADIS Geraghty & Miller personnel will coordinate all on-site activities with the Group and property owners prior to and during the investigation.

3.1 Project Organization

The project organization chart is shown on Figure 5 of the Pre-Design Investigation Work Plan. The following sections contain the definitions of responsibilities of the key project personnel.

Primary responsibility for project management is shared between the ARCADIS Geraghty & Miller Project Officer and the Project Manager. The ARCADIS Geraghty & Miller Project Manager serves as the primary contact for the U.S. EPA Remedial Project Managers. The Project Officer and Project Manager will be responsible for providing technical assistance for all activities which are directly related to the completion of the pre-design studies.

Responsibility for all quality assurance/quality control review lies with the QA/QC Advisor. Data processing will be overseen and reviewed by the Field Scientist and QA/QC Advisor. A QA/QC review of the data will be performed by the Data Validator, as discussed in Section 10. The review of all data will be conducted by the Project Officer and Project Manager. If quality assurance problems or deficiencies requiring special action are identified, the Project Officer, Project Manager, and QA/QC Advisor will determine the appropriate corrective action.

3.2 Field Organization

The ARCADIS Geraghty & Miller field team will be organized according to the planned activities. For the initial redevelopment activities, the field crew will consist of the Field Geologist. For the well installation activities, the field crew will consist of the Field Geologist and the drilling subcontractor. For the groundwater sampling activities the field crew will consist of two Field Geologists.

The Field Geologist will be responsible for the coordination of all personnel on site, and for providing technical assistance when required. The Field Geologist, or his/her designee, will be present during all drilling and sampling activities. He/she will keep a

general site log describing activities conducted on site, which will include the identification of personnel entering the site, and the recording of general observations regarding site activities. The Field Geologist will be responsible for providing technical supervision of the drilling subcontractor. In addition, he/she will be responsible for the geologic logging performed during the soil boring program.

The Field Geologist will also be responsible for coordination of all sampling efforts and will assure the availability and maintenance of the necessary shipping and packing materials, and sampling equipment. The Field Geologist will supervise the completion of all sampling documentation, ensure the proper handling and shipping of all the samples, and be responsible for the accurate completion of the field notebook. The Field Geologist will also assume custody of all samples and will be responsible for the completion of all chain-of-custody forms, maintaining communication with on-site personnel, logging all communications, and site entries and departures during sampling.

The Field Geologist, in conjunction with the QA/QC Advisor, will be responsible for the adherence of all QA/QC guidelines as defined in this QAPP. Strict adherence to these procedures is critical to the collection of acceptable and representative data.

The Data Validator is responsible for review of laboratory data for compliance with the precision, accuracy, representativeness, comparability, and completeness (the "PARCC" parameters), and notifications to the Project Manager of any QC deficiencies.

The project Site Safety Officer will be responsible for assuring that all field crew adhere to the site health and safety requirements. Additional responsibilities of the project Site Safety Officer are as follows:

- Updating equipment or procedures based upon new information gathered during the site operation.
- Modifying the levels of protection based upon information from the Field Geologist.
- Determining and supplying locations and routes to medical facilities, including poison control centers, and arranging for emergency transportation to medical facilities.

- Notifying local public emergency officers, including police and fire departments, of the nature of the team's operation and for supplying the telephone numbers of these departments to the field crew.

- Examining the field crew for symptoms of exposure or stress.

- Providing emergency medical care and first aid as necessary on site. The Site Safety Officer also has the responsibility to stop any field operation that threatens the health or safety of the team or the surrounding populace.

Tasks which will be performed by subcontractors include drilling, surveying, and analytical (laboratory) testing. Subcontractor managers have overall responsibility for the performance of their tasks in accordance with the project plans and specifications, interaction with the Project Manager, and adherence to the project schedule.

3.3 Laboratory Operations

Laboratory chemical analyses of all groundwater samples will be performed by Savannah Laboratories, Inc. of Savannah, Georgia. The applicable Standard Operating Procedures and analytical Quality Assurance Program Plan (QAPP) for Savannah Labs are provided in Attachments B-1 and B-2 of this QAPP, respectively.

Cation exchange capacity testing of all soil samples will be performed by the ARCADIS Geraghty & Miller Treatability Laboratory in Raleigh, North Carolina or another commercial laboratory. The applicable testing procedure (USEPA SW-846 Method 9081) is provided in Attachment B-3.

The Group reserves the right to utilize an alternate laboratory for the analytical work. If an alternate laboratory is to be utilized, the Group will notify the USEPA.

4.0 Quality Assurance Objectives for Measurement Data

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instruments, calibration, laboratory analysis, reporting of data, internal quality control, audits, preventative maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

4.1 Level of Quality Control Effort

The sample collection and analysis program consists of the sampling of groundwater from on-site and off-site monitoring wells. Site-specific control measures involving the collection of field duplicates and field blanks will be used to assess the quality of the data. Field blanks will be submitted to the analytical laboratory to assess the quality of the data resulting from the field sampling program. Field blanks are analyzed to check for procedural contamination at the site, which may cause sample contamination. Duplicate samples are analyzed to check for sampling and analytical reproducibility. A summary of the field duplicates and field blanks that will be collected is provided in Table 1.

Field blank and field duplicate samples will be taken in each location, on-site, and at the off-site locations. These samples, field blank and field duplicate, will be taken at a rate of 1 per every twenty samples, and will be submitted to the project laboratory for appropriate analyses. All samples will be collected in the same manner as the original samples.

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified in the particular method used and the Savannah Laboratories QAPP (Attachment B-2).

4.2 Accuracy, Precision and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

Accuracy is the relationship of the reported data to the "true" value. It is a measure of the bias in a measurement system which may result from sampling or analytical error. Sources of error which may contribute to poor accuracy include laboratory error, sampling inconsistency, field contamination, laboratory contamination, handling, matrix interference, and preservation. The accuracy of the methods used for the groundwater samples will be determined from the analysis of field duplicates and field blanks. Field blanks will collected at the frequency specified in Section 4.1 of this QAPP. The compounds used and their accuracy limits are set by the methods used, and are outlined in Tables 5-1 and 5-2 of the Savannah Laboratories QAPP (Attachment B-2).

Precision is defined as a measure of the reproducibility of individual measurements of the same property under a given set of conditions. It is a qualitative measure of the variability of a group of data compared to their average value. Precision is generally monitored through the use of duplicate analyses, with results expressed in terms of relative percent difference (RPD), or relative standard deviation (RSD). Measurement of precision is dependent upon sampling technique and analytical method. Both sampling and analysis will follow strict protocols as outlined in the FSP and this QAPP, respectively, to provide consistency necessary to meet precision objectives. Precision objectives are also outlined in Tables 5-1 and 5-2 of the Savannah Laboratories QAPP (Attachment B-2).

The estimated quantitation limits for analyses are specified in Table 3. Quantitation levels may be affected by matrix interference, such as those caused by highly contaminated samples. In a case in which method specified detection limits are not achieved, sample/extract cleanups will be performed if appropriate. If the quantitation limits are still not achievable, the applicability of the data, with respect to meeting project objectives, will be evaluated by the Project Manager and the QA Officer.

4.3 Completeness, Representativeness, and Comparability

Completeness is a measure of the amount of valid data obtained from the measurement system, compared to the amount that was expected to be obtained under normal conditions. It is expected that the laboratory will provide data meeting QC acceptance criteria for 90 percent or more of all samples tested using the requested determinations. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness\ (\%) = \frac{number\ of\ valid\ data}{number\ of\ samples\ collected\ for\ each\ parameter\ analyzed} X\ 100$$

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this network, consideration was given to existing analytical data. The rationale of the sampling network is discussed in detail in the FSP. Representativeness will be satisfied by ensuring that the FSP is followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded by the laboratory. Representativeness will be assessed by the analysis of field duplicate samples.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedure and QA objectives.

5.0 Sampling Procedures

Sampling procedures are described in the FSP (Appendix A of the Pre-Design Work Plan). This plan includes information on sampling procedures, equipment decontamination, sample documentation, sample shipping, and chain-of-custody. Preservation, container, and holding time requirements for the parameters to be analyzed are presented in Table 2.

6.0 Sample Custody

The primary purpose of sample custody procedures is to create a written record that documents a sample from the moment of collection through analysis. The resulting information aids in data interpretation and serves as legal evidence of sample handling.

Sample custody procedures are designed to comply with USEPA requirements for sample control. All samples will remain in the custody of sampling personnel from the time of collection until transfer to a representative of the courier service for delivery to the laboratory. Samples collected during the Pre-Design Investigation activities will be the responsibility of identified persons from the time the samples are collected until they, or their derived data, are incorporated into the final report. Stringent chain-of-custody procedures will be followed to document sample possession.

6.1 Field Chain-of-Custody Procedures

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain-of-custody intact.

6.1.1 Field Procedures

The procedures to be followed in the field are listed below.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.
- All sample containers will be labeled with sample numbers and locations.
- The project manager will review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

6.1.2 Field Logbooks/Documentation

Field logbooks will provide the means of recording data collecting activities performed. Entries will be described in as much detail as possible so that persons going to the site may reconstruct a particular situation without reliance on memory.

Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned;
- Logbook number;
- Project name;
- Project start date; and,
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the FSP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected and volume and number of containers. Sample identification number will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

6.1.3 Transfer of Custody and Shipment Procedures

The following procedures will be used when transferring custody of samples:

(a) Only shipping containers which meet all applicable State and Federal Department of Transportation standards for safe shipment will be used.

(b) The Chain-of-Custody Record and Laboratory Task Order (as applicable) will be placed inside the shipping container in a sealed plastic envelope. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents custody transfer of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

(c) Samples requiring refrigeration will be promptly chilled with ice or "Blue Ice" to a temperature of 4°C. Samples will then be properly packaged for shipment, and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

(d) If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

6.2 Laboratory Chain-of-Custody Procedures

The chain-of-custody procedures for the laboratory are described in the laboratory QAPP (Attachment B-4).

7.0 Calibration Procedures and Frequency

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment which are used for conducting field tests and laboratory analyses. These instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

7.1 Field Instruments/Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. The operating range and detection limits for field instruments are included in FSP Attachments A-4.

Equipment used during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to ensure that all maintenance requirements are being observed.

Field instruments will include a YSI Model 6820, which measures temperature, conductivity, dissolved oxygen, pH, turbidity and oxidation/reduction potential via an in-line, flow-through sensor, and the YSI 610-D display. Calibration of field instruments will be performed according to the procedures and at intervals specified in FSP Attachments A-3 through A-4.

In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for services. A log book will be kept documenting calibration results for each field instrument. The log book will include the date, standards, personnel, and calibration results.

7.2 Laboratory Instruments

Calibration procedures and frequencies for laboratory equipment used in the analysis of environmental samples will be performed in accordance with those specified in the methods and the laboratory QAPP (Attachment B-2).

8.0 Analytical Procedures

All groundwater samples collected during field sampling activities for the pre-design investigation will be analyzed by Savannah Laboratories, Inc. of Savannah, Georgia. Soil samples collected for analysis of cation exchange capacity will be analyzed by ARCADIS Geraghty & Miller's treatability laboratory in Raleigh, North Carolina or another commercial laboratory as appropriate.

8.1 Laboratory Analysis

The groundwater monitoring well network of 36 wells will be sampled twice in two separate rounds during the Pre-Design Investigation. The groundwater samples will be submitted to Savannah Laboratories of Savannah, Georgia (project laboratory) for analyses of the parameters listed in Table 3. During the initial round, groundwater samples will be collected from each of the monitoring wells at the Main Industrial Site and submitted to the project laboratory for analysis of the Target Analyte List (TAL) of metals for both total metals (i.e., unfiltered samples) and dissolved metals (i.e., filtered samples). The groundwater samples collected from the Remote Fill Areas will be submitted for laboratory analysis of TAL lead for both total lead (i.e., unfiltered samples) and dissolved lead (i.e., filtered samples). The groundwater samples collected for total lead analysis will be collected using low-flow sampling methods.

During Round 1, three separate sampling methods will be utilized at each well (depending on the analyte) as follows:

(1) Low-flow sample collection (to minimize entrainment of sediments/solids) using a submersible pump;

(2) Low-flow sample collection using a submersible pump with in-line field filtration of the sample prior to collection and preservation (i.e., dissolved analyte analysis); and

(3) Standard sampling methods using a disposable bailer and without sample filtration (i.e., total analyte analysis).

A second round of groundwater sampling will be conducted at the Main Industrial Site following receipt of the results from the first round of sampling. Groundwater samples collected during the second round of sampling will be analyzed for the reduced set of TAL metals for both dissolved (filtered) and total (unfiltered) metals. The groundwater samples collected for total metals analyses will be collected using low-

flow sampling methods. Field measurements of pH, conductivity, ORP, temperature and turbidity will also be collected during the second sampling event.

9.Table 1 presents the laboratory analytical parameters for the groundwater sampling events. The analytes include TAL metals, total dissolved solids, turbidity, sulfate, pH, temperature, conductivity, oxidation/reduction potential, sodium, potassium, calcium, magnesium, alkalinity, and nitrogen species. Not all of the analytes will be analyzed in each of the rounds. The details of the analytical program are presented in Table 1.

9.0 Internal Quality Control Checks

9.1 Field Sample Collection

The Field Geologist will collect field blanks and field duplicates to ensure and document the integrity of sample collection, sample handling procedures, and the validity of the measurement data. The frequencies for collecting the QC samples are specified in Table 1 and the procedures for collecting the QC samples are specified in the FSP.

9.2 Field Measurement

QC procedures for field parameter measurements will be performed by obtaining multiple readings on a single sample or standard and by calibrating the instruments. The operating procedures to be followed when taking these measurements can be found in Attachments A-4 of the FSP.

9.3 Laboratory Analysis

There are two types of quality assurance mechanisms used to ensure the production of analytical data of known and documented quality, analytical method QC, and program QA. The internal quality control procedures for the analytical services on environmental samples to be provided are specified in the methods to be used. These specifications include the types of control samples required (calibration standards, sample spikes, surrogate spikes, internal standards, controls, blanks), the frequency of each control, the compounds to be used for sample spikes and surrogate spikes, and the quality control acceptance criteria. It will be the laboratory's responsibility to document in each package that both initial and on-going instrument and analytical QC criteria are met. This documentation will be included in the packages generated by the laboratory.

The field-collected quality control sample results will also be compared to acceptance criteria, and documentation will be performed showing that criteria have been met. The following procedures will be employed by the laboratory for this site investigation:

- Proper storage of samples;
- Use of qualified and/or certified technicians;

- Use of calibrated equipment;
- Formal independent confirmation of all computation and reduction of laboratory data and results; and,
- Use of standardized test procedures.

10.0 Data Reduction, Validation and Reporting

All data collected during the site investigation, including field and laboratory results, will be reduced, reviewed, summarized, and reported.

10.1 Data Reduction

The reduction of the field data will consist of summarizing the raw field data. They will be presented in the form of tables, logs, illustrations, and graphs, as deemed appropriate by the Project Manager.

The analytical data from the laboratory will be reduced to appropriate forms as determined by the Project Manager. The original data and reduced form will be maintained at the ARCADIS Geraghty & Miller office for a period of time consistent with the requirements of the statement of work. The reduced data will be checked against original data to determine if transcription or calculation errors have occurred.

10.2 Data Validation

The sample data collected will be screened for completeness and technical compliance. The data provided by the laboratory will consist of Level III deliverables for the Round 1 sampling, and of Level IV deliverables for the Round 2 sampling, as specified in the ARCADIS Geraghty & Miller Analytical Quality Assurance and Laboratory Contract Program Guidance Manual. Currently, the data validation guideline document is the 'USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (1994). A copy of Level III/IV laboratory reporting requirements is provided in Attachment B-3. The information to be screened for the Level III/IV data will include:

- Check to see if the field chain-of-custody form was filled out and if samples were properly logged.
- Check to see if parameters were analyzed by the methods identified in the QAPP.
- Check to see if holding times were met for each parameter.
- Review internal quality assurance/quality control (QA/QC) data. Confirm that blanks were analyzed on the minimum number of samples as specified in the QAPP.

- Review all blanks and duplicates data. If target compounds appear in blanks or if percent relative difference on duplicates is outside established limits, the reasons for these anomalies will be investigated. In such an event, sampling techniques will be discussed with the project manager and/or the laboratory manager and internal QA/QC data will be reviewed as appropriate.

- If data appears suspect, the specific data of concern will be investigated.

If a problem is encountered after conducting a Level III/IV data review, it may be necessary to review all the data, including the raw data, for the sample or samples in question. In that case, the data needed to produce an ARCADIS Geraghty & Miller Level III package would be requested from the laboratory.

10.3 Data Reporting

The analytical data, including quality control samples, will be reported in tabular form with identification of sample number, matrix, parameters, detection limits, and concentrations detected. The data tabulations will be sorted by classes of constituents.

The tables and logs will be compiled whenever feasible by the Field Geologist, who will inform the Project Manager of any problems encountered during data collection, identify apparent inconsistencies, and provide opinions on the data quality and limitations. The tables and logs will be used as the basis for data interpretation and will be checked against the original field documentation prior to use by an independent reviewer.

11.0 Performance and System Audits

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. System and performance audits will be performed periodically, as appropriate, to assure that the work is being implemented in accordance with the FSP and in an overall satisfactory manner.

- The Field Geologist will supervise and check on a daily basis that field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and that the field work is accurately and neatly documented. QC checklists will be filled out daily during sampling as described in the FSP. External audits of field activities may also be conducted by the USEPA MQAB/CDO.

- On a timely basis, the Data Validator will check the data packages submitted by the laboratory to verify that the data has been obtained through the approved methodology with the appropriate level of QC effort and reporting, holding times were met, and that the results are in conformance with the QC criteria. On the basis of these factors, the Data Validator will evaluate the data quality and limitations.

- The Project Manager will oversee the Field Geologist and Data Validator and check that management of the acquired data proceeds in an organized and expeditious manner.

- System and performance audits for the laboratory may be conducted by the USEPA MQAB, as well as by various state agencies. These audits are discussed in the laboratory QAPP (Attachment B-2). In addition, ARCADIS Geraghty & Miller conducts a system audit of the laboratory once every two years.

12.0 Preventative Maintenance

ARCADIS Geraghty & Miller has established a program for the maintenance of field equipment to ensure the availability of equipment in good working order when and where it is needed:

- The Equipment Manager keeps an inventory of the equipment in terms of items (model and serial number), quantity, and condition. Each item of equipment is signed out when in use, and its operating condition and cleanliness checked upon return. The Equipment Manager conducts routine checks on the status of equipment, and is responsible for the stocking of spare parts and equipment readiness. The Equipment Manager maintains the equipment manual library and trains field personnel in the proper use and care of equipment.

- The Field Geologist is responsible for working with the Equipment Manager to make sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions before being taken to the job site.

The laboratory follows a well-defined program to prevent the failure of laboratory equipment and instrumentation. This preventative program is described in the Savannah Laboratories QAPP (Attachment B-2).

13.0 Specific Routine Procedures to Assess Data

The field and laboratory generated data in the investigation will be assessed for its precision, accuracy representativeness, completeness and comparability. Both qualitative and quantitative procedures will be used for these assessments.

13.1 Field Measurements

Field data will be assessed by the Field Geologist. The Field Geologist will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple readings of a single sample. Data completeness will be calculated using Equation 13-1.

Equation 13-1

$$Completeness = \frac{Valid\ Data\ Obtained}{Total\ Data\ Planned} X\ 100$$

13.2 Laboratory Data

Laboratory results will be assessed for compliance with required precision, accuracy, completeness, and sensitivity as discussed below

13.2.1 Precision

Precision of laboratory analysis will be assessed by comparing the analytical results between laboratory duplicate analyses for inorganic analysis. The relative percent difference (RPD) will be calculated for each pair of duplicate analysis using the Equation 13-2.

Equation 13-2

$$\%\ RPD = \frac{S - D}{(S + D) / 2} X\ 100$$

Where:

S = First sample value (original value)

D = Second sample value (duplicate value)

13.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in Section 3.0 of the QAPP using the analytical results of method blanks, reagent/preparation blank, field duplicates and field blanks.

13.2.3 Completeness

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using Equation 13-1.

13.2.4 Sensitivity

The achievement of method detection limits depends on instrumental sensitivity and matrix effects. Therefore, it is important to monitor the instrumental sensitivity to ensure the data quality through constant instrument performance. The instrumental sensitivity will be monitored through the analysis of method blanks, calibration check samples, and laboratory control samples.

14.0 Corrective Actions

Corrective actions may be required for two classes of problems: analytical or equipment problems, and noncompliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

For noncompliance problems, a corrective action program will be implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Project Manager. If the problem is analytical in nature, information on these problems will be promptly communicated to the USEPA Quality Assurance Section. Implementation of corrective action will be confirmed in writing through these same channels.

Any nonconformance with the established quality control procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. If warranted, the Project Manager, or his designee, will issue a written statement for each nonconformance condition.

Corrective actions will be implemented and documented in the field log. No staff member will initiate corrective action without prior communication of findings through the proper channels. Additional work which is dependent upon an unacceptable activity will not be performed until the problem has been eliminated.

14.1 Sample Collection/Field Measurements

Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the Project Manager or designee. This manager will be responsible for assessing the suspected problems in consultation with the Project QA Manager on making a decision based on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the manager.

The manager will be responsible for ensuring that corrective action for nonconformances are initiated by:

- Evaluating all reported nonconformances;

- Controlling additional work on nonconforming items;
- Determining disposition or action to be taken;
- Maintaining a log of nonconformances;
- Reviewing nonconformance reports and corrective actions taken;
- Ensuring nonconformance reports are included in the final site documentation in project files.

If appropriate, the Project Manager will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- Report the measurement to check the error;
- Check for all proper adjustments for ambient conditions such as temperature;
- Check the batteries;
- Re-calibration;
- Replace the instrument or measurement devices;
- Stop work (if necessary).

The Project Geologist or their designee is responsible for all site activities. In this role, the Project Geologist is required at times to adjust the site programs to accommodate site specific needs. When it becomes necessary to modify a program, the responsible person notifies the Project Geologist of the anticipated change and implements the necessary changes after obtaining the approval of the Project Manager. The change in the program will be documented on the field change request form (FCR), and be signed by the initiators and the Team Leader. The FCR for each document will be numbered serially as required. The FCR will be attached to the file copy of the affected document. The Project Manager must approve the change in writing or verbally prior to the field implementation, if feasible. If unacceptable, the action taken

during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

14.2 Laboratory Analyses

The Savannah Laboratories maintain a corrective action system which is described in the Savannah Laboratories QAPP (Attachment B-2).

15.0 Quality Assurance Reports

The QA/QC Advisor will review all aspects of the implementation of the QAPP on a regular basis and prepare a summary report. Reviews will be performed at the completion of each field activity and reports will be completed at this time. These reports will include an assessment of data quality; the results of system and/or performance audits; changes in QA project plan; summary of QA/QC programs, training and accomplishments; significant QA/QC problems, recommended solutions, and results of corrective actions; and limitations on use of the measurement data. Any significant QA deficiencies will be reported and identified, and corrective action possibilities discussed.

The final report will contain QA sections summarizing data quality information collected during the project.

16.0 References

U.S. Environmental Protection Agency (USEPA). 1983. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans. QAMS-005/80.

U.S. Environmental Protection Agency (USEPA). 1986. Test Methods for Evaluating Solid Waste (SW-846).

U.S. Environmental Protection Agency (USEPA). 1991a. Region V Model Superfund Quality Assurance Project Plan (QAPP).

U.S. Environmental Protection Agency (USEPA). 1993. Data Quality Objectives Process for Superfund. EPA-540-R-93-071.

U.S. Environmental Protection Agency (USEPA). 1994. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA-540/R-94-013.

TABLES

Table 1. Summary of Sampling Activities and Parameters,
Groundwater Monitoring - Pre-Design Investigation,
NL Industries/Taracorp Site, Granite City, Illinois.

		Well Installation	Round 1					Round 2				Totals
			Unfiltered (low-flow)	Filtered (low-flow)	Unfiltered (bailer)	DQO Level	QA/QC Samples	Unfiltered (low-flow)	Filtered (low-flow)	DQO Level	QA/QC Samples	
Soil	Cation Exchange Capacity	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20
Groundwater	**Main Industrial Site**											
	Target Analyte List (TAL) Metals	-	-	-	30	III	4	-	-	IV	4	38
	Lead	-	30	30	-	III	8	30	30	IV	8	136
	Cadmium	-	30	30	-	III	8	30	30	IV	8	136
	2 Metals to be Determined	-	60	60	-	III	8	60	60	IV	8	256
	Total Dissolved Solids	-	-	-	30	III	4	30	-	IV	4	68
	Sulfate	-	-	-	30	III	4	30	-	IV	4	68
	Sodium	-	-	-	30	III	4	30	-	IV	4	68
	Potassium	-	-	-	30	III	4	30	-	IV	4	68
	Calcium	-	-	-	30	III	4	30	-	IV	4	68
	Magnesium	-	-	-	30	III	4	30	-	IV	4	68
	Alkalinity	-	-	-	30	III	4	30	-	IV	4	68
	Nitrogen Species	-	-	-	30	III	4	30	-	IV	4	68
	Turbidity	-	30	-	-	III	-	30	-	IV	-	60
	pH	-	30	-	-	III	-	30	-	IV	-	60
	Temperature	-	30	-	-	III	-	30	-	IV	-	60
	Conductivity	-	30	-	-	III	-	30	-	IV	-	60
	Oxidation/Reduction Potential	-	30	-	-	III	-	30	-	IV	-	60
	Remote Fill Areas											
	Lead	-	6	6	-	III	1	6	6	IV	1	26
	Total Dissolved Solids	-	6	6	-	III	1	6	6	IV	1	26
	Sulfate	-	6	6	-	III	1	6	6	IV	1	26
	Sodium	-	6	6	-	III	1	6	6	IV	1	26
	Potassium	-	6	6	-	III	1	6	6	IV	1	26
	Calcium	-	6	6	-	III	1	6	6	IV	1	26
	Magnesium	-	6	6	-	III	1	6	6	IV	1	26
	Alkalinity	-	6	6	-	III	1	6	6	IV	1	26
	Nitrogen Species	-	6	6	-	III	1	6	6	IV	1	26
	Turbidity	-	6	-	-	III	-	6	-	IV	-	12
	pH	-	6	-	-	III	-	6	-	IV	-	12
	Temperature	-	6	-	-	III	-	6	-	IV	-	12
	Conductivity	-	6	-	-	III	-	6	-	IV	-	12
	Oxidation/Reduction Potential	-	6	-	-	III	-	6	-	IV	-	12

Notes

1 30 monitoring well locations include MW101-111 (shallow), MW103-109 (intermediate depth), MW108 and MW109 (deep), five new well clusters (shallow and intermediate) at the Main Industrial Site, and a total of six new shallow wells at the remote fill areas

2 QA/QC samples include 1 field blank and 1 field duplicate for every twenty (20) samples, per matrix

3 DQO = Data Quality Objective to met by the Laboratory

Table 2. Sample Containers and Preservation for Parameters to be Analyzed, NL Industries/Taracorp Site, Granite City, Illinois.

Matrix	Parameter	Analytical Method	Sample Containers (a)	Preservative	Holding Times (b)
Soil	Cation Exchange Capacity	9081	1 pint	none	indefinite
Water	Sulfate	375.4	120 mL P	4 ° C	28 days
	Nitrate	353.2	120 mL P	4 ° C	48 hours
	Nitrogen species	353.2	120 mL P	4 ° C	48 hours
	Sodium	6010	--	HNO_3 to pH < 2	6 months
	Potassium	6010	--	HNO_3 to pH < 2	6 months
	Calcium	6010	--	HNO_3 to pH < 2	6 months
	Magnesium	6010	--	HNO_3 to pH < 2	6 months
	Total Dissolved Solids	160.1	100 mL P	4 ° C	7 days
	TAL Metals	6010	500 mL P	2 mL 1:1 nitric acid	6 months
	Redox	ASTM-1498-76	--	--	immediate
	Turbidity	180.1	100 mL P	4 ° C	48 hours
	pH	150.1	--	--	immediate
	Temperature	--	--	--	immediate
	Conductivity	--	--	--	immediate

Notes:

(a) Sample containers will be of demonstrated cleanliness as described in the laboratory QAPP.

(b) Holding time starts from time of sample collection.

mL milliliters

P = Polyethylene

Table 3. Laboratory Methods and Detection Limits for Groundwater Samples.
NL Industries/Taracorp Superfund Site, Granite City, Illinois.

TAL Metals	Method Number (SW-846)	Method Detection Limit
Soil		
Cation Exchange Capacity	9081	N/A
Groundwater		(ug/L)
Aluminum	6010	27
Antimony	6010	5
Arsenic	6010	3.2
Barium	6010	1.2
Beryllium	6010	0.54
Cadmium	6010	0.71
Calcium	6010	44
Chromium	6010	1.7
Cobalt	6010	1.4
Copper	6010	0.9
Iron	6010	18
Lead	6010	1.5
Magnesium	6010	110
Manganese	6010	1.4
Mercury	7470	0.072
Nickel	6010	4.7
Potassium	6010	190
Selenium	6010	4.2
Silver	6010	1.9
Sodium	6010	310
Thallium	6010	4.9
Vanadium	6010	2.2
Zinc	6010	5.9
Total Dissolved Solids	160.1	N/A
Turbidity	180.1	0.10 NTU
Sulfate	375.4	1.7
Nitrogen Species	353.2/353.3	0.01
Alkalinity	310.1	0.4
Oxidation/Reduction Potential	ASTM D1498-76	N/A

ug/L Micrograms per liter
mg/L Milligrams per liter
N/A Not applicable
NTU Nephelometric Turbidity Units

Appendix 5

ARCADIS GERAGHTY & MILLER, INC.
LEVEL II LABORATORY QUALITY ASSURANCE REQUIREMENTS

ARCADIS GERAGHTY & MILLER, INC.
LEVEL II LABORATORY QUALITY ASSURANCE REQUIREMENTS

I. LABORATORY REPORTABLES:

The following information will be included in the data package for each sample where applicable:

A. General Information:

1. The results of sample analysis;
2. The parameters of interest;
3. The method of analysis;
4. The detection limits of analysis;
5. For large numbers of samples per report, a master list of laboratory tracking ID numbers correlated with field sample ID numbers and sample analysis batch identification to correlate QA samples to sample analysis batch;
6. Sample collection date;
7. Sample received date;
8. Sample preparation/extraction data;
9. Sample analysis date;
10. Copy of the chain-of-custody form signed by the laboratory sample custodian;
11. A narrative summary identifying any QA or sample problems encountered, required sample manipulations (dilutions), and the corrective action taken.

Level II Reportables

B. Inorganics Analyses:

For inorganics analyses involving the use of atomic absorption (flame or furnace), inductively coupled plasma (ICP), ion chromatograph (IC), light (visible or ultraviolet) spectrophotometric methods, other turbidimetric, gravimetric, auto analyzer procedures and inorganic procedures generally referred to as "wet bench" chemistry, the following QA data should be provided where applicable.

1. Results of method blanks;

2. Results of batch specific laboratory duplicate or reagent water (blank) spike duplicate (of the compound or element of interest), expected value, percent recovery, calculated relative percent difference (RPD) and control limits;

3. Results of batch specific matrix spikes, expected value, percent recovery control limits, and source;

4. Results of laboratory control sample (LCS) or reagent water (blank) spike sample carried through the preparation method with the samples prior to analysis and analyzed along with the sample in the same analysis batch, expected value, percent recovery, and control limits.

5. Results of the associated initial calibration verification standard (ICVS) and all associated continuing calibration verification standard (CCVS) expected values percent recovery, and control limits.

C. Organics Analyses:

1. Gas Chromatography (GC) Analysis:

The results of the following analyses should be reported where applicable:

a. Blanks:

(1) Water blanks (non-extraction);
(2) Extraction blanks (Laboratory blank);
(3) Trip blanks

Note: Field blanks are treated as samples.

b. Results of batch specific matrix spikes (if required to satisfy the method), expected value, percent recovery, and control limits;

c. Results of batch specific laboratory duplicates or matrix spike duplicates, expected value, percent recoveries, relative percent difference (RPD), and control limits;

d. Results of surrogate spikes, expected value, percent recovery, and control limits;

e. Results of reagent water (blank) spikes and reagent water (blank) spike duplicate of compounds or elements of interest expected value and percent recovery, calculated RPD and control limits. Reagent water (blank) spike duplicate is not required if laboratory duplicate or matrix spike duplicate is analyzed satisfactorily.

2. GC/Mass Spectrometer Analysis:

The results of the following analyses should be reported where applicable:

a. Blanks:

(1) Water blanks;
(2) Extraction blanks;
(3) Trip blanks.

b. Results of batch specific matrix spikes (as required by the method), expected recovery, percent recovery, control limits;

c. Results of batch specific matrix spike duplicates (as required by the method), expected recovery, percent recovery, calculated RPD, and control limits;

d. Laboratory duplicates - optional;

e. Surrogate spikes expected value, percent recovery, and *control limits;*

f. Results of reagent water (blank) spikes and reagent water (blank) spike duplicate of compounds of interest (or matrix spiking compounds specific for the method), expected value, percent recovery, calculated RPD and control limits.

The following applies to both inorganic (metals and wet chemistry) and organic analyses, where applicable:

If samples are digested, extracted or otherwise prepared together in a batch and analyzed on different instruments or on the same instrument during different calibrations (e.g. on different days) then the laboratory is required to provide the stated deliverables for each analytical batch and for each instrument in the data package report. Included with this deliverable must be identification of which samples were analyzed under which quality control data and on which instrument. If the control samples are only periodically analyzed, then in addition to the stated deliverables the laboratory will be required to provide the initial and continuing calibrations results of the other instruments used for each day samples were analyzed without control samples as appropriate for the analysis, regardless of the level of reporting.

II. LABORATORY NON-REPORTABLES: (LEVEL II)

All raw data and data not included under the reportables described in paragraph I developed by the contracted laboratory during sample analysis must be maintained by the laboratory as a record for a period of three years unless specified otherwise by the contract. Such data may include, but not be limited to, the following:

A. Inorganics Analyses:

1. Concentration of calibration curve standards;
2. Results of linear range check samples for ICP;
3. Results of linear range (1 to 4) dilution sample for ICP;
4. Results of interference check sample (ICS) analysis and expected value (ICP only);
5. Results of analytical (post-digested) spike analysis;
6. Sequential measurement readout records;
7. Digestion logs;
8. Percent solids raw data;
9. Raw data calculation worksheets.

B. Organics Analyses:

Records of the analysis results of the following types of QA samples:

1. Initial calibration data;
2. GC/Mass Spectrometer tuning with BFB or DFTPP and mass calibration summary;
3. Continuing calibration standards including results of system performance check compounds (CCC) and expected results;
4. Response factors and relative retention time for each parameter;
5. Internal standard parameter (compound) and concentration;

6. Sample chromatograms; and

7. Mass spectral data tape for each sample.

NOTE: The laboratory non-reportable inorganic and organic information is not required to be submitted with the laboratory report, but should be available for audit review upon 30-days notice.

ENVIRONMENTAL WORKS
OUR EXPERTISE. YOUR SUCCESS.

July 23, 2018

Mr. Jeffrey A. Leed
Leed Environmental, Inc.
2209 Quarry Drive
Suite C-35
Reading, PA 19609

RE: Quality Assurance Project Plan Amendments (July 2018)
Five-Year Review Groundwater Sampling Activities
NL Industries/Taracorp Superfund Site, Granite City, IL

Dear Mr. Leed:

The purpose of this letter is to present updated information relevant to Environmental Works, Inc. (EWI) performing the five-year review groundwater monitoring at the NL Industries/Taracorp Superfund Site in Granite City, IL (Site). EWI will perform the work in accordance with the EPA-approved *Quality Assurance Project Plan* (QAPP), dated September 1999, with the following modifications:

- **Scope of Work** – Work performed by EWI will be completed in a manner consistent with the *Scope of Work Groundwater Monitoring for Five-Year Review* and tasks 1-5 defined in the associated transmittal letter from Leed Environmental to the United States Environmental Protection Agency dated July 2018. Language regarding the scope of work in these documents supersedes references to the "Pre-Design Investigation" found throughout the 1999 QAPP.

- **Approval Sheet** – An approval sheet, signed by pertinent project personnel, documenting that EWI will abide by the procedures outlined in the QAPP, as modified by this letter update, is attached.

- **Project Roles** - An updated project organization chart is attached and reflects the following changes:

    - Responsibility for project management of this work lies with the EWI Project Manager – Barbara Garcia, 417-890-9500.

1455 E. Chestnut Expy
Springfield, MO 65802
P: 471.890.9500
F: 417.823.9659

1731 Locust Street
Kansas City, MO 64108
P: 816.285.8428
F. 816.285.8409

530 Madison Street
Springdale, AR 72762
P: 479.250.4947

Jefferson City, MO

St. Louis, MO

24-Hr. 877.827.9500
www.environmentalworks.com

- Responsibility for all quality assurance/quality control review lies with the EWI Quality Assurance Manager – Bob Lanning, 417-890-9500

- Field work will be completed by a crew of EWI Associate Scientists. Prior to mobilizing to the Site, one Associate Scientist will be appointed by the EWI Project Manager to fill the Field Geologist, Equipment Manager, and Site Safety Officer roles outlined within the QAPP.

- Laboratory chemical analyses will be performed by TestAmerica. The TestAmerica Project Manager for this work is Richard Wright, 708-534-5200.

- **Laboratory Analytical Limits** – Updated laboratory data quality information including method detection limits, reporting limits, sample bottles and preservatives, and hold times relevant to this scope of work is attached.

- **Water Quality Monitoring** - A Yellow Springs Instrument (YSI) 6920 V2 Sonde with YSI 650 handheld unit and flow-through cell will be used to monitor groundwater quality parameters during sampling activities. This is a newer model of the device specified in the QAPP.

If you have any questions about these modifications to the QAPP, please feel free to contact me at 417-890-9500.

Sincerely,

ENVIRONMENTAL WORKS, INC.

Barbara Garcia
Project Manager/Registered Geologist

Attachments:
1. QAPP Approval Sheet
2. Project Organization Chart
3. Laboratory Data Quality Information

ATTACHMENT 1

QAPP Approval Sheet

1 – Approval Sheet

The signatures below denote the intent by Environmental Works, Inc. (EWI) to abide by the procedures outlined within the EPA-approved *Quality Assurance Project Plan* (QAPP), dated September 1999, for the NL Industries/Taracorp Superfund Site in Granite City, Illinois, as modified by the July 2018 QAPP amendments.

7/23/2018

Barbara Garcia
Environmental Works, Inc.
Project Manager/Registered Geologist

Date

7/23/2018

Bob Lanning
Environmental Works, Inc.
Quality Assurance Manager

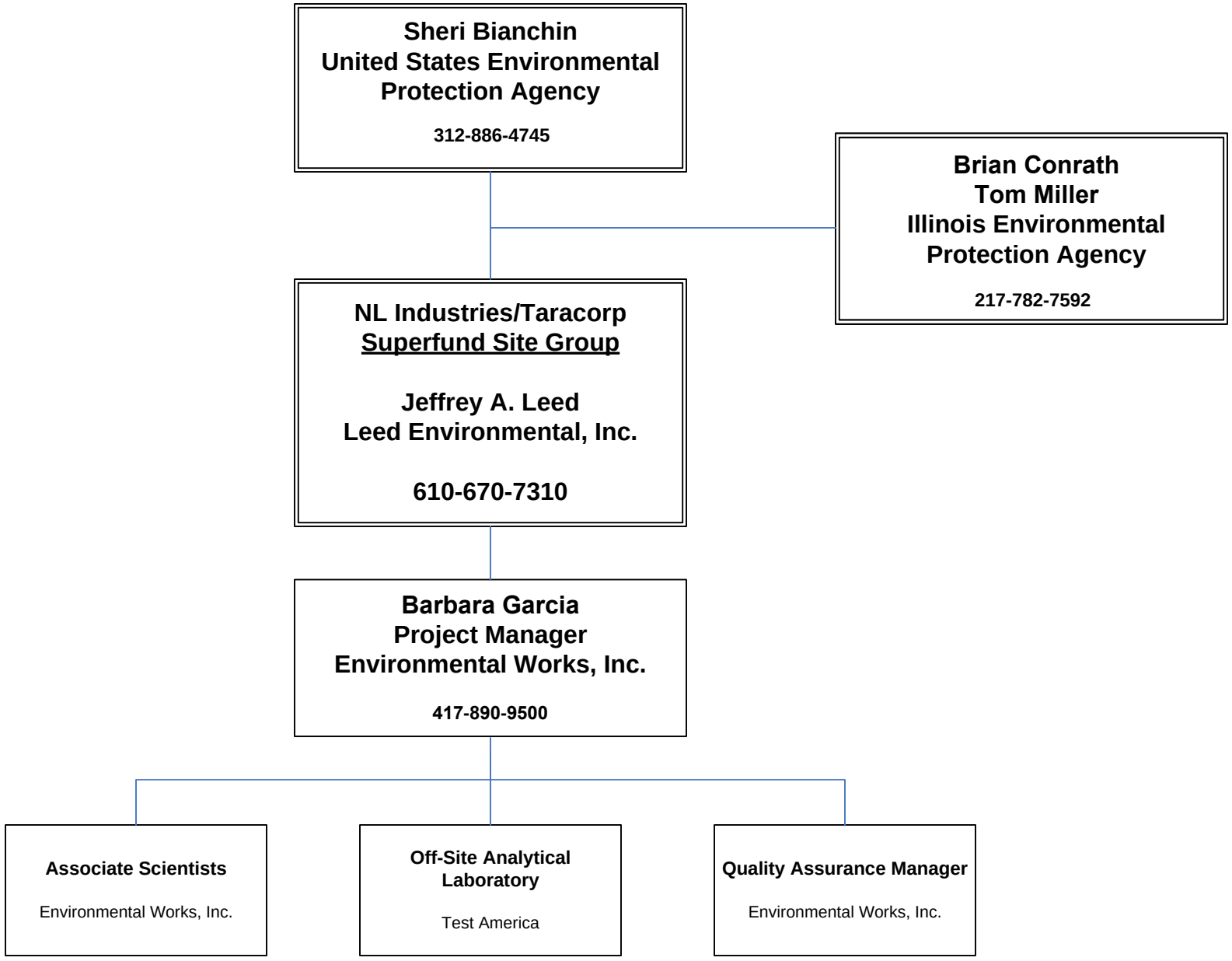
Date

ATTACHMENT 2

Project Organization Chart

Attachment 2

Five-Year Review Groundwater Monitoring Organization Chart
NL Industries/Taracorp Superfund Site
Granite City, Illinois



ATTACHMENT 3

Laboratory Data Quality Information

Analytical Methods
Method Detection Limits
Reporting Limits
Sample Containers and Preservatives
Hold Times

TestAmerica Chicago
2417 Bond Street
University Park, IL 60484

Prepared for:
Barbara Garcia
Environmental Works, Inc.
1455 East Chestnut Expressway
Springfield, MO 65802
bgarcia@environmentalworks.com

Prepared by Wright, Richard C
Date
Expiration Date 12/31/2018
Est. Start Date 6/21/2018

Project: NL Industries/Taracorp *Quote Number: 50009163 - No Version*

Short List Metals

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	6010B	Total Pb, Cd, Zn	Cadmium	0.00200	0.000433	mg/L
			Lead	0.00500	0.00270	mg/L
			Zinc	0.0200	0.00500	mg/L

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	6010B	Dissolved Pb, Cd, Zn	Cadmium	0.00200	0.000433	mg/L
			Lead	0.00500	0.00270	mg/L
			Zinc	0.0200	0.00500	mg/L

Metals & Wet Chemistry

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	6010B	Metals - 12 Elements	Arsenic	0.0100	0.00365	mg/L
			Barium	0.0100	0.00123	mg/L
			Cadmium	0.00200	0.000433	mg/L
			Chromium	0.0100	0.00169	mg/L
			Copper	0.0100	0.00179	mg/L
			Iron	0.200	0.0819	mg/L
			Lead	0.00500	0.00270	mg/L
			Manganese	0.0100	0.00226	mg/L
			Nickel	0.0100	0.00185	mg/L
			Selenium	0.0100	0.00532	mg/L
			Silver	0.00500	0.00148	mg/L
			Zinc	0.0200	0.00500	mg/L

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	7470A	Mercury	Mercury	0.200	0.0984	ug/L

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	SM 5210B	BOD	Biochemical Oxygen Demand	2.00	2.00	mg/L

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	SM 2540D	Solids, Total Suspended (TSS)	Total Suspended Solids	5.00	1.93	mg/L

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Water	9014	Cyanide	Cyanide, Total	0.0100	0.00345	mg/L

RL	MDL	Units

TestAmerica Chicago
2417 Bond Street
University Park, IL 60484

Prepared for:
Barbara Garcia
Environmental Works, Inc.
1455 East Chestnut Expressway
Springfield, MO 65802
bgarcia@environmentalworks.com

Prepared by Wright, Richard C
Date
Expiration Date 12/31/2018
Est. Start Date 6/21/2018

Project: NL Industries/Taracorp *Quote Number: 50009163 - No Version*

Metals & Wet Chemistry

Matrix	Method	Test Description	Analyte	RL	MDL	Units
Continued						
Water	1664A	Oil and Grease (HEM)	HEM (Oil & Grease)	5.00	1.32	mg/L
				RL	MDL	Units
Water	9066	Phenolics, Total Recoverable	Phenolics, Total Recoverable	0.00500	0.00411	mg/L
				RL	MDL	Units
Water	9040C	pH	pH	0.200	0.200	SU

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Prepared by Wright, Richard C
Date
Expiration Date 12/31/2018
Est. Start Date 6/21/2018

Project: NL Industries/Taracorp *Quote Number: 50009163 - No Version*

Analytical Sample Information

Analysis Method	Matrix	Preservative	Client Sub List Desc Container	Volume Required	Holding Time
BOD, 5-Day			BOD		
5210B	Water	None	Plastic 1 liter - unpreserved	500 mL	48 Hours
Cyanide			Cyanide		
9014	Water	Sodium Hydroxide	Plastic 250ml - with Sodium Hydroxide	75 mL	14 Days
HEM and SGT-HEM			Oil and Grease (HEM)		
1664A_Calc	Water	Sulfuric Acid	Amber Glass 1 liter Wide - Sulfuric Acid	2000 mL	28 Days
Mercury (CVAA)			Mercury		
7470A	Water	Nitric Acid	Plastic 250ml - with Nitric Acid	50 mL	28 Days
Metals (ICP)			Dissolved Pb, Cd, Zn		
6010B	Water	Nitric Acid	Plastic 250ml - with Nitric Acid	75 mL	180 Days
Metals (ICP)			Metals - 12 Elements		
6010B	Water	Nitric Acid	Plastic 250ml - with Nitric Acid	75 mL	180 Days
Metals (ICP)			Total Pb, Cd, Zn		
6010B	Water	Nitric Acid	Plastic 250ml - with Nitric Acid	75 mL	180 Days
pH			pH		
9040C	Water	None	Plastic 1 liter - unpreserved	60 mL	IMMEDIATELY
Phenolics, Total Recoverable			Phenolics, Total Recoverable		
9066	Water	Sulfuric Acid	Amber Glass 500mL - Sulfuric Acid	150 mL	28 Days
Solids, Total Suspended (TSS)			Solids, Total Suspended (TSS)		
2540D	Water	None	Plastic 1 liter - unpreserved	300 mL	7 Days

Hold Times listed above represent the minimum allotted time between sampling and lab extraction, prep or analysis.

Multiple analyses may be consolidated into fewer containers. Please contact your Project Manager for clarification when requesting sample containers.

Except for some special tests, all samples should be kept cold at 6 degrees C.